REVIEWED
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RADEON HD 7970
AMD's new performance GPU blows away the competition

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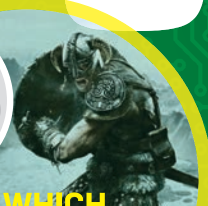
MAXIMUM PC 2011 GAMING AWARDS



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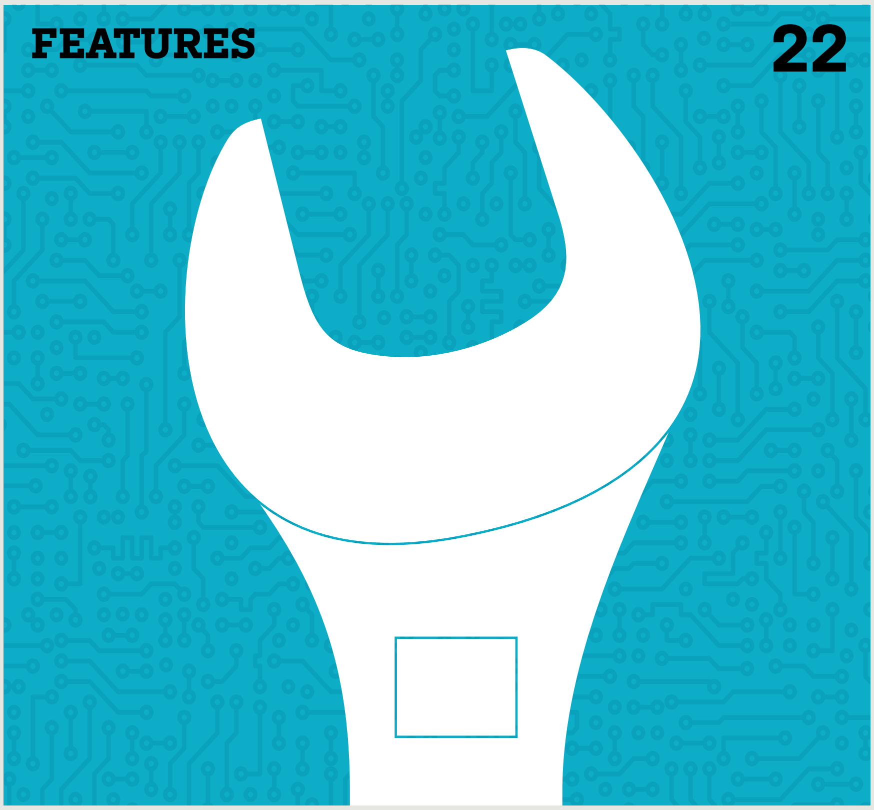

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MAXIMUM PC

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Gordon Mah Ung

THE SECRET TO TECH SUCCESS, FOR FREE

PAY CLOSE ATTENTION, because I'm about to give you the secret to success in all things tech. You'll learn why Netflix still dominates, why Amazon's Instant Video is a bomb, and why Android has taken iOS off its high horse and tossed it into a 1,000-foot ravine. I'll also tell you how Microsoft Windows Phone 7 can succeed, and why the Kindle Fire is on fire. And you don't even have to attend some high-priced conference and watch some 22-year-old billionaire with a headset, goatee, and flip flops strut around a stage, either.

Here it is: We consumers are cheap bastards, and we want value. Got it?

I have both Netflix and Amazon Prime (why? Free shipping, baby), but I never, ever, touch Amazon Instant Video. Why? Navigating what to watch on Amazon Instant Video is like trying to free-wheel a quad ATV through a minefield. It's free, right? Yes, no, maybe, because every other link has a price tag attached to it. I'm sure there are some free videos in there, but everything seems to just be a sampler that leads to paying another $1.99 for a video. Netflix, on the other hand, is a wonderful free-for-all of video where every single last thing is free (well, once you've paid the price of admission). Yeah, Netflix is slowly being gutted by the Hollywood studios, so much so that I expect in two years it'll be like a paid version of YouTube—only in Korean—but for now, the fact that I don't get surcharged every four clicks makes it clear why it's the consumers' number one choice.

Know why Android is the world's top smartphone OS? It's cheap. Phones are cheap. Apps are cheap—which is great, because consumers are cheap. Want to know how cheap? I bought the 10-cent apps that went on sale, even though I already had them for free through the Free App of the Day at the Amazon App Store (you got that one right, Amazon). Why? They were cheap!

Microsoft certainly didn't get that memo when it encouraged Windows Phone 7 developers to charge higher prices than elsewhere. The result? Paying $6.99 for something I can get free or for 99 cents elsewhere. Guess where that train is going? Off the cliff. Want to give WP7 a fighting chance, Microsoft? Dig in to your war chest and give all your new phone OS customers a $50 app store credit to convert their iOS/Android apps to WP7. Oh, and encourage developers to charge lower prices, not higher.

Experts predicted the Amazon Kindle Fire would have absolutely no impact on the iPad since the devices "don't compete," but guess what happened this Christmas? Maybe one or two *million* iPad 2s left rotting on shelves while people reached for the Kindle Fire. Why? Better? No. Faster? No. Cheaper? Yes. *Way* yes.

There you have it, the secret to tech success. For free.

Gordon Mah Ung is Maximum PC's deputy editor, senior hardware expert, and all-around muckraker.

submit your questions to: comments@maximumpc.com

THE NEWS

Hard Drive Apocalypse?

Shortages, price spikes, consolidation, and gimped warranties shake the hard drive industry

AS WE ENTER 2012, it's perhaps fitting that we also seem to be approaching some kind of hard drive apocalypse.

The situation kicked off when six months of deadly monsoon rains in Thailand last year swamped factories that produce parts used in 25 percent of the world's hard drives. Vendors, in turn, began hoarding drives in anticipation of short supplies, which tripled and quadrupled the prices of some drives seemingly overnight. The situation looked so grim that Intel trimmed its revenue forecast by $1 billion in the belief that PC sales would drop. Major PC makers including HP, Lenovo, Dell, and Acer followed suit, forecasting that PC orders would likely slow as they ran out of hard drives to build into them.

Hard drive makers in turn broke the seventh seal by deciding that it was now time to drastically cut the warranties on drives, with some going from five years to one year. Add to that a consolidation that will see the market shrink from five hard drive makers to two, and it's no wonder people are wondering if a *storagealypse* isn't upon us.

John Rydning, a research vice president at IDC, says it's not the end times by any stretch of the imagination, but it'll be rough for a while—partly due to the overreaction of vendors.

Not everything looks horrible, though. Kristopher Kubicki, chief architect with data-mining firm Dynamite Data, says they're seeing signs that the great storagealypse may already be easing. Dynamite Data tracks inventories from more than 600 online stores, and while inventories seemed to literally fall off a cliff in October, the supply has lately been trending up with prices coming down.

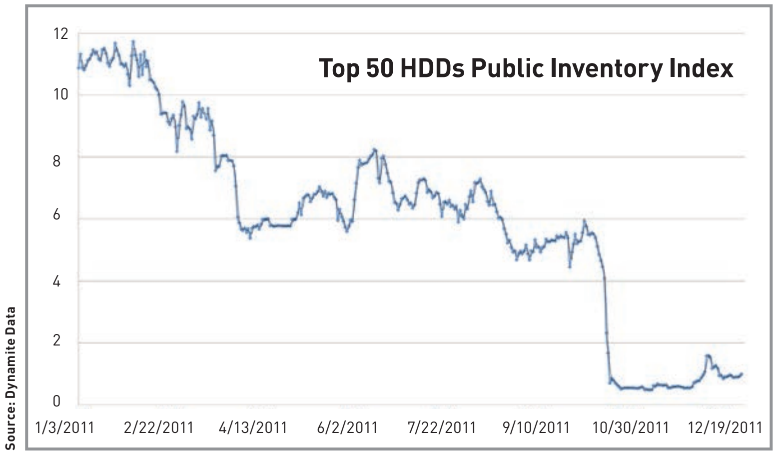
At its worst, a 2TB Western Digital Caviar Green hit $250, which is a big increase from its low of about $70 just a month before. At press time, the same drive was selling for $160 at some sites.

"It looked like the Armageddon that didn't come," says Kubicki. Still, Kubicki says that a recovery spike in late December, which had previously led him to believe the worst was over, has since petered out. However, drive availability continues to move in the right direction.

Rydning agrees that we're not out of the woods just yet. He says vendors will likely work through supplies of existing components and near-finished drives, and then supplies could tighten up a bit before easing again once production is ramped up. He expects it to take well into this year to fully recover.

Rydning said another casualty of all this may be the rock-bottom prices consumers have been used to seeing. Unlike DRAM makers, who go through boom and bust every few years, hard drives prices tend to go down and stay down. With the recent flood, Rydning says drive makers will likely reset prices in their favor.

The consolidation of Seagate and Samsung, combined with Western Digital's intent to buy Hitachi (if it passes regulatory concerns) will further keep prices high, as fewer players means the manufactures will be able to more accurately forecast the demand. **–Gordon Mah Ung**



Inventories of the top 50 hard drives had been trending down, but fell off a cliff in October, according to Dynamite Data.

Early Medfield Benchmarks Impress

VR Zone has posted some tantalizing performance numbers for a reference tablet featuring a 1.6GHz Intel Medfield chip running Android Honeycomb. The 32nm SoC reportedly managed a score of around 10,500 in the CaffeineMark 3 Java benchmark, while current platforms such as Nvidia Tegra 2, Qualcomm Snapdragon MSM8260, and Samsung Exynos all range between 7,500 and 8,500 in the same benchmark.

The chip is said to be consuming 2.6W of power when idle and 3.6W while playing back 720p Flash video. The final product is expected to consume 1W less in both scenarios. Intel plans to begin shipping the chip in early 2012. **–PC**

AT&T Backs out of T-Mobile Buyout

Facing an antitrust suit from the Department of Justice and further hearings from the FCC, AT&T in December opted to drop its $39 billion bid for T-Mobile, a move that would have made Ma Bell the number one telecom in the country. As a result, AT&T will have to pay T-Mobile a cool $3 billion in cash, and about another billion worth of network and spectrum sharing. AT&T claims that the failed merger will exacerbate the existing spectrum shortage, causing higher prices and lower-quality service for millions of Americans. Fact, or preemptive excuse-making? **–MR**

Gordon Flashes Supreme

Surprisingly, no one has named a supercomputer after our intrepid deputy editor Gordon Mah Ung (yet), but the San Diego Supercomputer Center (SDSC) did name one after Flash Gordon, an appropriate namesake for the world's first supercomputer to rely entirely on flash memory for storage.

"Think of Gordon as the world's largest thumb drive, but with the capability to ingest about 220 movies per second from Netflix, or consume the entire catalog of about 100,000 Netflix movies, while still having room for another 200,000 titles," the SDSC writes. "That's a lot of popcorn."

SDSC claims it's secret sauce, Gordon's flash storage system, is capable of handling massive databases at speeds up to 100 times faster compared to HDD systems. Gordon's storage capacity currently sits at 4 petabytes, which accounts for the bulk of the $20 million, five-year grant from the National Science Foundation.

Gordon recently ranked among the top 50 fastest supercomputers in the world in terms of speed or doing pure math. **–PL**

Photo credit: Alan Decker

Tom Halfhill
Fast Forward

3D CHIPS DRAW NEARER

WE'RE NOT quite there yet, but 3D chip stacking is edging closer to mainstream reality. The most important recent strides are the Micron-Intel Hybrid Memory Cube and Xilinx's Stacked Silicon Interconnect. Both use a crucial wiring technology called through-silicon vias (TSVs).

Just to be clear, I'm talking about 3D chip stacking, not 3D transistors. As I wrote last August, Intel's new 22nm chip-fabrication process uses nonplanar tri-gate (FinFET) transistors, whose 3D structures rise above the chip's flat silicon substrate. But these chips still have only one die. In 3D stacking, a single-chip package contains multiple die, each with its own layer of transistors, stacked like floors in a multistory building.

Stacking isn't new, but existing examples are relatively crude. Usually, the layers are wired together around the edges. Moving electrical signals between layers is like crawling out the window of a building, climbing the fire-escape ladder to the next floor, and then crawling back inside. Unless you are Spider-Man, it's faster to ride a centrally located elevator.

TSVs are like elevators—they are vertical wires built straight through the multiple die layers. Signal paths are much shorter, so the chips can run faster and use less power.

Micron and Intel jointly developed the Hybrid Memory Cube, which will stack eight DRAM chips in one package. Production samples are expected next year. Although their initial cost will limit them to high-end systems at first, memory cubes are a big step toward the mass market.

Meanwhile, Xilinx is using TSVs to make the world's largest-capacity field-programmable gate array (FPGA), which is available now. Technically, this device is 2.5D, not 3D, because it links four chips horizontally using TSVs and a foundation wiring layer. But it's another step toward true 3D chips, which will probably be commonplace in five to 10 years.

Tom Halfhill was formerly a senior editor for Byte *magazine and is now an analyst for* Microprocessor Report.

Thomas McDonald
Game Theory

WHERE RPG AND FPS MEET

NOSTALGIA IS A strange thing. As a product of memory filtered through emotion, it tends to have a warping effect on reality. As Skyrim and Diablo 3 became the subject of conversation among gamers, I started getting emails from old-timers wondering whether I could recommend any "real" role-playing games, like they used to make. You know... *back in the day*!

I understand the question. I even sympathize with it a bit, despite having poured 90-plus hours of pure gaming bliss into Skyrim. When I analyzed the question more carefully, however, I began to wonder: What, exactly, are people remembering? What do they want back? What was that Golden Age of Role-Playing (or is it just a Gold Box?) that was more pure, more satisfying, and just more, well... role-playish? Did it even exist, or was it a by-product of memory and emotion?

Definitions matter. There are RPG fans who don't consider Skyrim a "real" role-playing game, but rather an action game dressed up in role-playing clothing. I get this. The unimpeded full-screen view of the world, the bobbing weapons, the click-to-attack mechanics: These are all the legacy of FPS titles.

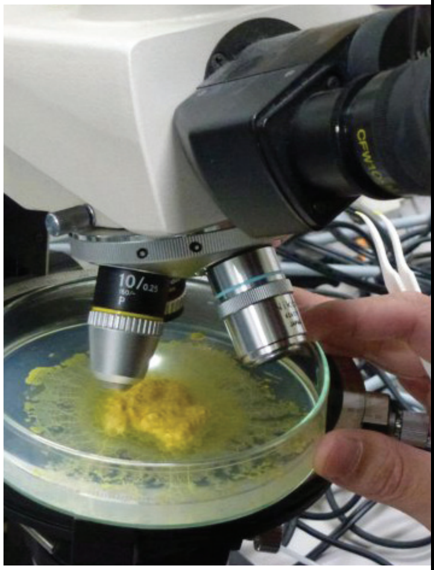
In ye olde tymes, there was always plenty of stuff on the screen to remind you this was a serious game: character portraits, stats, interface controls, maps, dialog boxes, and probably a few more stats. Go look at an old Might and Magic or Wizardry screen: The character view uses only about one-third of the total screen space.

There was a reason for that, of course, and it had nothing to do with all that depth and pure gaming goodness people seem to recall. It had to do with the sucktastic graphics of the time. As computers got better, character views got larger, until the stats and controls vanished, and the entire screen became a window on a whole new world.

Let's be honest: There's a class of hardcore RPG fan who likes to feel superior to FPS fans, so it's not surprising to find a you-got-your-chocolate-in-my-peanut-butter reaction to Skyrim. Bethesda hasn't placed the focus on complex combat, but on world-building and, well, playing a role. Isn't that what an RPG is all about?

You can follow Thomas McDonald on Twitter @StateOfPlayBlog.

Bio-Computers Get Slimed



Japanese scientists think they've found the organism that can make intelligent bio-computers possible: amoeboid yellow slime mold. That's right, the nasty goop covering downed trees and leaves is actually a pretty intelligent little bugger.

Atsushi Tero of Kyushu University says the simple slime mold exhibits information processing in the way it finds food, following an optimized path more efficiently than even modern day computers.

In Tero's slime mold studies, the icky organism naturally created a railway pattern that is remarkably similar to the existing rails found in the Kanto region of Tokyo, which is kind of exciting—in a gross way. **–BC**

IBM Predicts Mind-Reading Tech

Within five years, IBM believes we'll see early applications of mind-reading technology that up to now have been mere science fiction fantasies. The geeks in blue are already researching ways to link your brain to electronic devices. For example, you could simply think about calling someone, and your smartphone would do it. Looking longer term, IBM believes brain control will take over manual typing.

Mind reading is just one of five bold predictions IBM announced in December as part of its "5 in 5" initiative, an annual forecast of future innovations, which in years past has proven fairly accurate. This year's other predictions include: 1) Personal energy will power your home, 2) you'll never need a password again, 3) the digital divide will vanish, and 4) junk mail will become priority mail. Learn more at bit.ly/zqB4IF. **–PL**

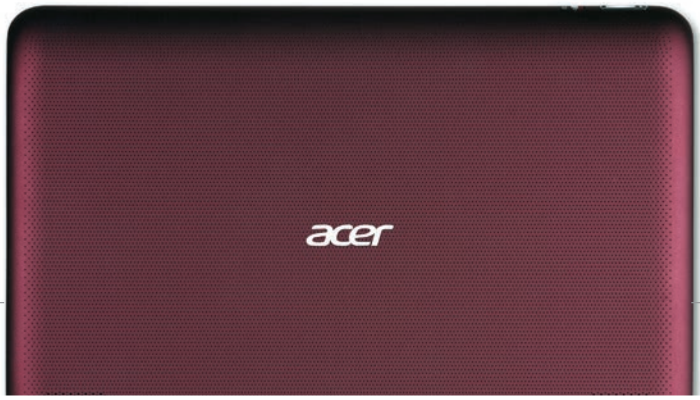
Windows 8 Watch

Look at All These Rumors

As some questionable speculation flies concerning developer interest in Windows 8, the new hardware rumor mill churns on.

After ad network Chitika reported that the number of ad impressions coming from Windows 8 Developer Preview has dropped significantly since September, some pundits have postulated that the level of anticipation and activity among developers must be waning when it should be spiking. Of course, cooler heads chalk up the ad impression drop to the number of lay people who probably downloaded the preview just to check out the drastically new Metro interface and then move on.

Meanwhile, Intel's Ivy Bridge and mobile x86 Clover Trail chips are revving to go, with hardware rumors in tow. Asus is said to be working on a swivel-screen ultrabook/tablet hybrid for Computex 2012, which will run Windows 8 on Ivy Bridge chips. Both Acer and Lenovo are eyeing Q3 to release high-powered Clover Trail tablets running Windows 8. **–MR**



Quinn Norton
Byte Rights

A SECOND SHOT AT THE 4TH AMENDMENT

GOOD NEWS, everybody! We might actually get our day in court about being wiretapped without a warrant for the last nine years or so. In 2004, Mark Klein retired from AT&T and later went to the EFF with documentation of a secret room installed at AT&T by the NSA to eavesdrop on Internet traffic.

The EFF launched two cases to fight the warrantless wiretapping: Jewel v. NSA, which directly sued the government for spying on its people, and Hepting v. AT&T, which sued the telecom companies for helping them. For a while it looked like Hepting was the case to watch, after the government failed to get it thrown out with the State Secrets Privilege. But Congress reacted to that by creating a bill that gave the telecom companies retroactive immunity for helping the government spy on its people. The bill killed the case, and as far as anyone knew, the government just kept on spying on us this whole time. Jewel was dismissed as being not even a real case, but just a general complaint.

However, the EFF appealed both decisions, and in the last gasp of 2011, the appeals court upheld Congress' right to give companies legal immunity for helping them spy on people, while also upholding the right of the people to directly sue the government for spying on them. Jewel v. NSA was remanded to the lower court to try the case for real this time. It seems likely to get past the inevitable State Secrets challenge, since the relevant documents were published by *Wired* six years ago. This starts the whole cycle again. And even if the people win—a long shot, to be sure—it will be years before they stop spying on us. So for now, you can still leave "Hi, Mr. NSA agent!" in your email sig.

Quinn Norton writes about copyright for Wired News and other publications.

Zeo Sleep Manager Mobile

Oh, how nice it would be to sleep on a cloud mattress carried by angels with heavenly lullaby voices. But at least we geeks have access to more corporeal sleep aids, like the Zeo Sleep Manager Mobile ($99, www.myzeo.com). Its key component, the Zeo Software biometric headband, fits around your forehead and tracks your sleep stages, synching to your Android or iOS device. The Zeo app then wakes you up at an optimal moment of your sleep cycle within a predetermined window of time.

Dock the headband to the charger, and the data of your night's slumber syncs to the app, as well as to your MyZeo web page, where you can get a sleep history showing your total hours of Zs from each night, broken down into deep, REM, and light sleep. You get nightly and average "ZQ" and "Morning Feel" scores, to see how you're doing compared to what's considered optimal. Additional graphs, a journal, and coaching tools can help you figure out why you may be getting 7–8 hours a night but still wake up feeling like the walking dead.

While we had some trouble keeping the headband in place through the entire night, the Zeo Mobile is still a huge boon for health nuts and personal data miners alike. **–MR**

Data Transfer Record Smashed

A multinational group of researchers developed a technology that transfers two-way data at a rate of 186Gb/s, making the 10Gb/s of Thunderbolt look absolutely sluggish.

The team achieved the new world record tapping into a 100GB circuit between the University of Victoria in British Columbia and the Washington State Convention Center in Seattle. They sent 98Gb/s in one direction and 88Gb/s in the other, for a spiffy total of 186Gb/s.

Don't expect such speeds on your desktop, though. The technology was developed primarily for the staggering data generated by high-end physics apparatuses, such as the Large Hadron Collider at CERN in Switzerland. –BC

Security Flaw Stains WPS

The widely used Wi-Fi Protected Setup (WPS) standard is not as protected as router makers thought. Security researcher Stefan Viehböck showed that the PIN codes used to lock down the system can be brute-forced on many devices by inputting incorrect PIN codes.

Incorrect PIN entries are met with an EAP-NACK message, whose code can actually reveal the first half of the PIN. The last digit is always the checksum of the PIN, so the number of possible PINs drops from 100 million to just 11,000. Many routers do not implement a lockout policy for repeated incorrect PINs, so an automated system could try all the possible permutations to gain access. **–RW**

THE LIST

8 GREAT GAMES FOR LESS THAN $20

8 BASTION

The affecting narration and strange world turns this simple Diablo clone into something deeper and, shall we say, philosophical? $15, www.supergiantgames.com

4 LIMBO

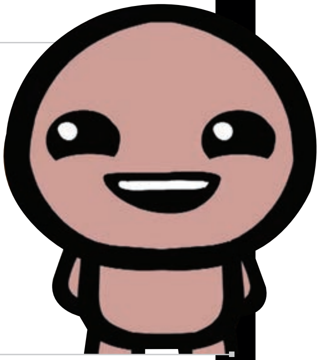
A haunting world filled with giant spiders and deadly traps; get through each puzzle using nothing but running, jumping, pushing, and pulling. $10, **www.limbogame.org**

7 FROM DUST

Lead your ragtag tribe to safety and glory by altering terrain to create pathways, defenses, and structures. $15, bit.ly/znbVR3

3 SINS OF A SOLAR EMPIRE

One of the best RTS games in the past several years; build a space empire, conquer star systems, and eventually rule the galaxy. $15, www.sinsofasolarempire.com



2 THE BINDING OF ISAAC

This retro-style indie gem crams a randomly generated dungeon crawler and a top-down shooter into a neat action-package. $5, www.bit.ly/xJUGP8

6 ORCS MUST DIE

Another take on a combination shooter and tower defense game, with a touch of light humor. $15, www.robotentertainment.com

1 SECTION 8: PREJUDICE

What Unreal Tournament 3 should have been. Engage in conquest or assault scenarios across lush maps, complete side missions, and fight for objectives. $15, www.warisprejudice.com

5 SUPER MEAT BOY

A loving homage to 8-bit, SMB packs in pixel-perfect platforming, a chiptune soundtrack, and hours of gameplay. $15, www.supermeatboy.com

HEAD TO HEAD

BY DAN SCHARFF

Steam vs. Origin

For years, digital distribution of PC gaming has been a one-horse race, dominated by Valve's Steam. Though other digital storefronts exist, like GOG, Impulse, and Direct2Drive, no other service has had the clout or the marketing dollars to stand up to Valve... until now. Even though as recently as several months ago we were writing off Origin as a possible Steam competitor, EA has gone all-in with its fledgling digital gaming platform. So which is better?

Round 1: Client

While common sense would dictate that Steam's well-established software be miles ahead of EA's new kid on the block, the two clients are remarkably similar. Both clients offer a storefront, community, friends list, and links to settings and options. Both clients offer customizable in-game overlays. And while gamers may quibble about which client is more resource-heavy, both clients are lightweight enough to make any minute difference between the two inconsequential to actual game performance.

Still, Steam's client has had the benefit of years of iteration to make it a more intuitive and, subjectively speaking, nicer-looking interface.

Winner: Steam

Round 2: Community/ Online Services

Comparing online communities is a dangerous proposition, fraught with rabid fanboys and volatile flame wars. So instead, we'll compare the online services and options available to the warring services.

Steam's community integration is top-notch. Inviting friends to your games is quick and painless, IM and voice chat features are robust, community pages offer what's essentially a game-centric personal blogging service, and Steam forums have practically supplanted official game forums in many cases. And let's not forget features like auto-patching, cache checking, an online screenshot library management, game recommendation system, and cloud save system.

Origin has admittedly had some growing pains in the feature department. While it's clear EA intends to eventually add more functionality, at this point the only advantage Origin has over Steam is the ability to import friends lists from other services such as Facebook, PSN, and Xbox Live.

Winner: Steam

Round 3: Stability

Though both services are fairly straightforward, easy to use, and reliable, neither is without its share of problems. Steam has long been plagued by occasional service outages and interrupted downloads, especially during high-traffic sales periods. Offline mode continues to be a bugaboo, and often fails to work at all. Still, these slight hiccups pale in comparison to EA's issues. Despite Origin's relative newness, EA has already been embroiled in scandal surrounding its controversial EULA, Origin's legal status in Germany, as well as its controversial practice of prohibiting banned forum users from accessing their Origin accounts. Throw in problems users had launching the service during Battlefield 3's launch and some early crashing issues, and Steam is affirmed as the far less flaky choice.

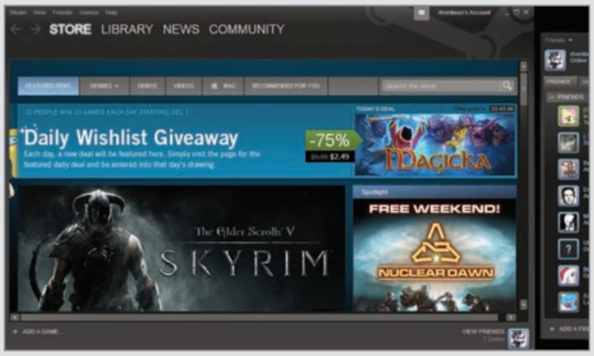
Winner: Steam

Round 4: New Releases

Here's where things start getting interesting. Though both services offer their share of pre-order bonuses and launch window specials, EA's Origin has actually been far more aggressive in its release window pricing. In a crowded and competitive marketplace, Origin is trying its hardest to rope in new gamers with better deals on the latest and greatest AAA titles. While Steam generally sets its new release price right about at MSRP, many new games on Origin have been discounted to $40 or less within a week of launch. Of course, this is all based on the U.S. market; if you live in Europe, you're screwed either way.

Winner: Origin

EA's Origin client has a clean and simple design... possibly due to its lack of features.



Steam isn't shy about advertising, but given the massive discounts on a huge variety of titles, most gamers aren't complaining.

Round 5: Game Library

No need to dissect this one: Steam wins. If Steam's library is the Great Library at Alexandria, Origin's is the beat-up bookmobile from your local library. Not only that; Steam's frequent bundles and sales make it a cinch to stock your digital stores with a treasure trove of backloggery. Still, we can't give EA too much guff here. For a service that as recently as several months ago was nothing but a download portal for EA-only games, Origin has made impressive steps toward expanding its selection. Steam will likely remain the archivists' choice for quite a while, but within a year or so, Origin's catalogue may be nothing to sneeze at.

Winner: Steam

And the Winner Is...

For now and the foreseeable future, **Steam**—with its impressive library of reasonably priced games, massive install base, and feature-rich client—is the platform, digital storefront, and PC gaming community of choice. But all is not lost for EA. If Origin, still technically a beta, continues to improve, it may emerge as a viable alternative to Steam. In the long term, however, the real winners might just be PC gamers, as more selection and competition in the free digital platform space spurs innovation and lower prices for all.

STEAM™

DOCTOR

THIS MONTH THE DOCTOR TACKLES...

>Overcooked RAM
>Virtualization Software
>Linux HDDs on Win7

Overcooked RAM

I overclocked my PC a while ago, and my computer memory somehow got ruined as a result. Do you know what happened? What's the safest way to overclock to protect my computer's memory? I have a 2.8GHz Intel Core i7-920 with 6GB of OCZ Platinum.

—Corbin Brown

THE DOCTOR RESPONDS: The Doc has never received a straight answer from RAM manufacturers as to what temperature ranges will lower the life of RAM, but when RAM dies, it's usually the result of being "cooked" by the graphics card or high voltage during the overclock. First, the good news: OCZ offers a lifetime warranty for all of its RAM products, so contact the company for further information. Second, that RAM is designed to run at DDR3/1600 at 1.65 volts. If you are exceeding that, it could be the cause of an early death. If you want to push beyond DDR3/1600, keep the voltage at 1.65 or lower by running a looser timing than the modules call for. On X58, the Doc has not seen huge boosts in performance beyond DDR3/1600 for most apps, so it makes sense to just run at 1,600MHz and lower for your future overclocks.

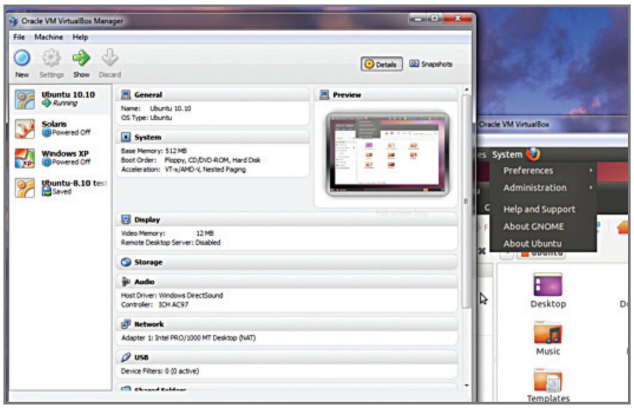
When Good is Too Good

Heroes of Might and Magic IV is an isometric, overhead-view, turn-based strategy game. With an AMD Athlon single-core processor (approx. 2.8GHz) I could play the game at its highest resolution (1280x1024) without any choppiness, even for the largest, most detailed maps. Now, with my quad-core 3.3GHz Intel Core i7-975 Extreme Edition, the choppiness is so heavy on some large maps that I have to play at 1024x768.

Am I doing something wrong? Should I adjust some setting? Or am I right in my suspicion that because older games do not support multicore processing, multiple cores are ripping me off?

—Russell O'Hara

THE DOCTOR RESPONDS: Ah, we're sure this situation will give die-hard AMD fans something to smile about: You can't run a game on your Core i7-975 Extreme Edition as well as you can on your AMD Athlon. Well, your hunch that a game (ported from the 3DO, no less) from 2002 is unlikely to support more than one core is right. However, the Doc can assure you that just one core of a 3.3GHz Core i7-975 will indeed run circles around a 2.8GHz Athlon. The Doctor also notes that the game's recommended configuration is a 450MHz Pentium III with 256MB of RAM and an SVGA card. Assuming you are running Windows 7 or Windows Vista, it's likely an issue with the OS and/or drivers for this ancient game. You have two options. The first is the well-known DOSBox emulator (see our article about how to use it at bit.ly/aTVERa). Another option is to give VirtualBox 3.0 (www.virtualbox.org) a spin. You'll need a copy of Windows XP handy to create the install, and you'll need to follow these directions (bit.ly/5PBIZz) to set up DirectX support under VirtualBox 3.0. The Doc suspects that you can run the game virtualized in a window with no issues on your rig while watching video and running Folding@home, too.



VirtualBox is freely available open-source virtualization software backed by Oracle. It supports many guest operating systems, including Windows 3.x, XP, 2000, NT 4.0, server 2003, Vista, and Windows 7, as well as Linux and others.

Four-Card Draw

In late 2010, I built a computer from scratch to suit my gaming needs. It sports an Intel Core i5-760 with the 1156 socket, dual Nvidia GTX 460s in SLI (that run my primary monitor), as well as an Nvidia GT 220 that runs my secondary monitor. All of this is plugged into an MSI P55-GD80 motherboard with 8GB RAM, running Windows 7 64-bit.

I bought a Creative SB X-Fi to run my sound, and my system won't recognize all four cards at once. I want the soundcard because the on-

↘ submit your questions to: doctor@maximumpc.com

board chip doesn't have all the features I want. Additionally, I have a RAID controller I want to use. Currently, everything works with one 460, the 220, the soundcard, and the RAID controller. Is there not a motherboard out there that will meet my needs? Obviously, finding one with enough slots for all of these cards is a challenge, particularly given the size of the 460s, which tend to cover other slots. A rep at the local electronics store told me the 1156 boards were having problems when trying to use all of the available PCIe slots, and now 1156 motherboards are becoming hard to find. I hate that my other 460 is just sitting on the shelf.

—Dan Schmidt

THE DOCTOR RESPONDS: You're running into the limited amount of PCIe lanes available in the LGA1156 platform. There are 16 PCIe Gen 2 lanes available in the "Lynnfield" Core i5-760 processor, and another eight x1 PCIe lanes in the P55 chipset. Depending on how your motherboard configures the PCIe lanes, some of them can be shut down if you run the two x16 physical PCIe slots in x8 mode. Some P55 boards (such as the now hard-to-find Asus P7P55D-E Deluxe) dealt with this issue by splitting the bandwidth of the limited eight x1 PCIe lanes using a PLX switch chip. The situation didn't get that much better with LGA1155, but some boards using nForce2 chips to split and load PCIe bandwidth handle it a little better. If you need expansion, the best option is to use the new LGA2011, which has 40 PCIe lanes (some of them PCIe 3.0) in the CPU and can run all of the slots "hot" all of the time with very little compromise. Looking at a couple of online stores, the Doc sees that LGA1156 is indeed very difficult to find in a higher-end configuration. If you can find it, the Asus P7P55D Deluxe might help solve some of your problems, but it depends on what your RAID controller's PCIe requirements are. Sadly, the most cost-effective bet may be to sell off your LGA1156 and move to an LGA1155. Your two board options would be the Gigabyte GA-Z68-UD7-B3, which features an nForce 200 PCIe controller and offers tri-SLI support, or the cheaper Asus P8Z68 Deluxe Gen 3.0 board, which also has a PLX controller and supports standard SLI.

CPU Upgrade Time?

I want to upgrade from my Wolfdale Core 2 Duo to at least a quad-core processor, but I am not sure if it is worth a new processor and mobo. I'm currently running an Nvidia GeForce GTX 560 Ti with 8GB of DDR3/1600 and the dual-core Wolfdale, which I believe is a 2.93GHz Core 2 Duo E7500 chip. I can run Skyrim well, but I feel like my CPU is bottlenecking. Whenever I check, its usage is around 80 percent or higher in Skyrim.

—Joe B.

THE DOCTOR RESPONDS: Normally, gaming is all about the GPU—so long as you have enough CPU, you can keep the game engine running at top speed. The Doctor would normally say to eke out a little more performance by overclocking your system a bit. If you're willing to take the risk, you can probably get another 500-600MHz out of the chip on a conservative overclock. The E7500 does suffer from having half the cache of the E8000 series of Core 2 Duos. That's not a big deal for most games, but Skyrim likes big, fat, hairy CPUs and is probably one of the few games benefiting from Intel's new Core i7-3960X part. That's because of how Skyrim offloads some of its graphics chores. If you want to see your CPU drag you down, crank the graphics detail to the higher quality settings. Obviously, a $1,000 Core i7-3960X or even the $600 Core i7-3930K is a little rich for most people's pockets. So the Doc offers three options: The cheapest option is to overclock that Wolfdale and see if you can live with its Skyrim performance. Second, build a new system with either a Core i5-2500K or Core i7-2600K/2700K. The 2500K/2600K/2700K is currently the steal of the century on performance-to-price ratio. The last option is the least recommended: Find an older Core 2 Quad "Yorkfield" processor on eBay. Used Yorkfield prices are plain dumb (it's cheaper to buy a Core i5-2500K, for example), but if you do go this route, make damned sure your motherboard supports Yorkfield, as some earlier nForce-based motherboards supported dual-cores but not quad-cores.

Hold on, Future Boy

I want to get more space on my Alienware M17x R3, but the Dell guy says it can only take 1,500GB. How can I get two 3TB WD Caviar Greens into the two HDD modules? Do I replace the motherboard?

—Gabe

THE DOCTOR RESPONDS: Gabe, the best way to get two 3TB drives into your laptop is to wait a few years until 3TB laptop drives exist. The only 3TB drives in existence are 3.5-inch desktop drives; your notebook only takes 2.5-inch drives. Right now, the highest-capacity drives that will fit in your laptop are 1TB 5,400rpm drives, which are slower than the two 750GB 7,200rpm drives that ship with your laptop. Doctor's orders: Stick with what you have for now. If you need more storage, invest in a USB 3.0 external drive. That will let you add terabytes of storage to your computer without a time machine.

Linux HDDs on Win7

After reading your review of the MvixBOX NAS in October 2008, I bought one and installed two mirrored 1TB drives. The box recently became inaccessible on my LAN. The status light consistently blinks, and the LAN light is off. I reset the box by holding down the two front-panel buttons and turning on the power, and I was able to see a status-type window in my browser, but it will not boot or let me access the Admin window for configuration. I have basically given up on the box. However, I need the data on the drives. I mirrored the drives for redundancy in the event that a drive failed. Who thinks about the box failing? I figured they were probably FAT or FAT32 formatted and thought I could connect a drive externally to my Win7 Ultimate machine and move the data to my Windows Home Server. The Home Server only backs up NTFS drives, so that data was not moved to the server. I knew I should have used SyncBackSE to move the data to the server. Oh well. I connected a drive externally to my Windows machine and could not see it with Windows Explorer. I ran Zero Assumption recovery, and it identified the partitions as Linux. After two hours of running it had barely made progress, so I canceled it, not knowing if it was reading the data correctly. How do you suggest retrieving files from a Linux-formatted HDD that is connected directly to a Windows 7 machine? There are many results online, but I am looking to you as the master and all-knowing one.

—Todd C

THE DOCTOR RESPONDS: The recovery program was correct in that the drive is formatted for Linux; specifically, the MvixBox seems to use EXT2 or EXT3 filesystems. You can read and write to EXT2 or EXT3 filesystems from Windows by installing the Ext2 IFS utility (www.fs-driver.org). Once it's installed, you ought to be able to read and write to that drive exactly as if it were an NTFS or other Windows-native filesystem.

HACK YOUR HARDWARE

By Marco Chiappetta

11 DIY PROJECTS TO UNLEASH YOUR GEAR'S HIDDEN POWER—FOR FREE!

THERE ARE SEVERAL practices that distinguish true power users from common folk. System building is one. Component benchmarking certainly applies. As does religious parts swapping. And then, of course, there's hardware hacking. Hacking, more than anything else, exemplifies our ongoing quest for more—more performance, more functionality, more power—because we're wringing this extra goodness from gear we already own, using crafty methods and occasionally pushing the bounds of practicality in the process; sometimes just for the heck (or should we say *hack*?) of it.

We know that GPUs and CPUs often have features disabled or dialed back in order to fit a price point. We'll show you some nifty ways to access their hidden capabilities, as well as some fixes for inherent flaws. We also know that our gear can be made to do more than it was intended to with the help of third-party software, as you'll discover in our webcam and Roku projects. And if you want to make your smartphone smarter, increase your Wi-Fi router's range, or RAID your SSDs, we'll turn you on to those tricks, too.

So what are you waiting for? Let's get hacking!

OVERCLOCK AMD BULLDOZER

After years of AMD hyping the Bulldozer microarchitecture for its supposed efficiencies, the initial batch of Bulldozer-based AMD FX Series processors arrived with a resounding thud due to disappointing performance and relatively high power consumption. But amid all the fervor following the launch, many enthusiasts seem to have missed the fact that AMD's current flagship FX-8150 is still technically the fastest desktop processor the company has released to date. Of course, being the fastest processor in AMD's lineup doesn't mean there isn't some frequency headroom left under the hood. It turns out that the Bulldozer-based AMD FX-8150 is a pretty decent overclocker.

We all saw the reports of AMD's Bulldozer breaking overclocking records and earning a place in the Guinness World Records. But those overclocks were performed with liquid-helium cooling, binned chips, extreme voltages, and only a single Bulldozer module (two cores) enabled. Overclocking a retail-ready processor with all of its cores enabled using more traditional cooling methods is a different story altogether. Luckily, not much has changed with Bulldozer in the overclocking department; the tried and true methods of tweaking multipliers, voltages, and the HyperTransport clock that worked with the Phenom II carry over to Bulldozer, as well.

The AMD OverDrive real-time overclocking and system-monitoring utility is a great tool for tweaking the performance of a Bulldozer-based system when used in conjunction with the right motherboard.

We set out to see what kind of overclocks were possible with an AMD FX-8150 using a standard air-cooler and an AMD 990FX-based Asus motherboard. Instead of using the motherboard's UEFI to overclock, though, we turned to AMD's OverDrive utility, which lets users overclock from within Windows in real-time without having to reboot and waste time constantly restarting a system.

Because FX Series processors are "unlocked," their multipliers can be raised or lowered to increase or decrease the CPU frequency at will. Increasing or decreasing the HT clock has the same effect, and pumping more voltage into a chip will typically allow for higher frequencies, as well, provided it is adequately cooled.

The FX-8150 has a base clock of 3.6GHz, which will dip down to 1.4GHz while idling. When half (or fewer) of its cores are being utilized, the FX-8150 is able to Turbo up to a peak frequency of 4.2GHz. When all of its cores are being fully utilized, the FX-8150 can Turbo up to 3.9GHz. And while all of this is happening, the processor's voltage will fluctuate between approximately .85v and 1.36v. By disabling Turbo, turning the voltage up beyond 1.4v, and cranking up the CPU multiplier with AMD's OverDrive utility, all of the cores on the chip can run at even faster speeds and offer much better overall performance.

How much faster the FX-8150 will run varies from chip to chip, but we found that at 1.4125v, our CPU could reliably hit 4.41GHz (22x multiplier x 200MHz HT clock). At frequencies any higher at that voltage, the test bed was unstable, and pumping upwards of 1.5v into a 32nm chip with air cooling isn't ideal. To hit 4.41GHz, we simply launched OverDrive, chose Advanced mode, disabled Turbo, and moved the CPU multiplier and voltage sliders as necessary. Please note that the CPU settings in your BIOS/UEFI should be set to Auto should you want to experiment with OverDrive.

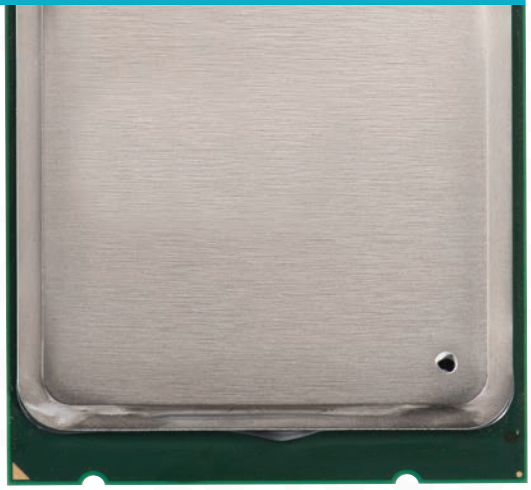
When running at 4.41GHz, the FX-8150 offered up a Cinebench R11.5 score of 7.31, an increase of 1.3 points, or 21.6 percent, over the stock score of 6.01. And its temperature peaked at only 71 C. That kind of performance boost won't allow the FX-8150 to overtake many of Intel's faster chips, but it's a huge gain nonetheless and one that's easily obtained using OverDrive.

AMD CORE UNLOCKING: UNLEASH DORMANT CPU CORES

IN THE EARLY STAGE of a processor architecture's lifetime, it is common for multicore dies with nonfunctional cores to be harvested for use in lower-end products, while fully functional dies end up at the high-end. Over time, however, as manufacturing processes mature and yield increases, there are fewer and fewer dies with nonfunctional elements to harvest. If there is still demand for lower-cost processors, though, in lieu of expending engineering resources designing a new, cheaper-to-produce core, chip makers like AMD will often disable perfectly good cores in an existing CPU design to satiate the market.

Such is the case with a number of chips in AMD's aging Phenom II product line. After years in production, yields are high on quad-core versions of the chip, but there is still a relatively large demand for cheaper, dual- and triple-core Phenom II processors. As such, many of those dual- and triple-core chips have additional cores on-die that are functional, but dormant. Manufacturers of enthusiast class motherboards, however, have devised BIOS/UEFI-level tricks to un-

OVERCLOCK INTEL SANDY BRIDGE-E



Intel's Sandy Bridge-E is a beast of a microarchitecture. It takes many of the good things about the already awesome Sandy Bridge and vastly expands upon them. Whereas Sandy Bridge-based processors sport up to four cores, 16 lanes of integrated PCIe 2.0 connectivity, dual-channel memory controllers, and 8MB of shared L3 cache, Sandy Bridge-E features eight cores, 40 lanes of PCIe 3.0-class connectivity, quad-channel memory, and up to 20MB of shared L3. We should point out, though, that current SNB-E based desktop processors have only four or six cores enabled and up to 15MB of shared L3.

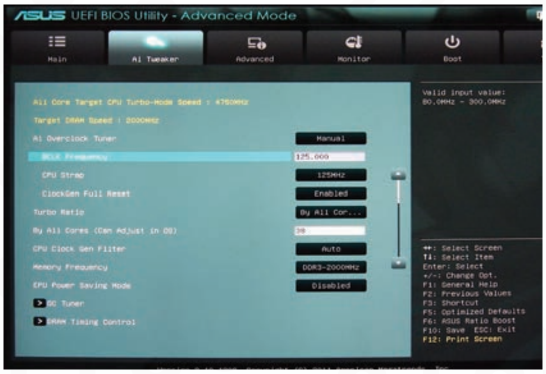
The sum of SNB-E's parts results in the fastest desktop processors Intel has released to date. Of course, there's always some room for improvement with a little overclocking. Unfortunately, SNB-E inherited one of SNB's undesirable traits, as well—a finicky BCLK, or base clock. Like original Sandy Bridge-based parts, Sandy Bridge-E processors offer limited flexibility for overclocking when using BCLK manipulation. Users who want to alter CPU and memory frequencies via the BCLK are limited to just a few MHz in either direction (approximately 3-5MHz). With Sandy Bridge-E, however, two new BCLK multiples (125MHz and 166MHz) are also available that were not with Sandy Bridge, so there is some fun to be had there. Like K-Series SKUs, though, Core i7 Extreme Editions are fully unlocked, meaning CPU, Turbo, and memory clocks can all be adjusted by using different multipliers.

When overclocking SNB-E chips, power and cooling considerations are paramount. Running at its stock 3.3–3.9GHz speeds, the Core i7-3960X is rated for 130W, but power consumption and heat output increase substantially when the chip is overclocked. With that in mind, Intel and its motherboard partners have incorporated options to dynamically increase voltages when necessary and specify peak current thresholds. These new options and SNB-E's more demanding power and heat considerations make the overclocking process somewhat more complex, but if you don't feel like tinkering much and have a good cooler and PSU, playing with voltages and multipliers are all that is necessary to achieve some monster overclocks with SNB-E. We should also point out that although options are available to disable SpeedStep and various C states, overclocking SNB-E only requires finding the right combination of BCLK, voltage, and maximum Turbo frequencies. By altering those options alone and not messing with SpeedStep or C states, the processor can still throttle down while idle to minimize power consumption and temperatures.

To give you some examples, most SNB-E-based processors can achieve 4.5GHz with decent air or liquid cooling. A large percentage of the chips can do 4.6GHz to 4.7GHz with minimal effort, and 4.8GHz should be doable with the right voltage (1.4v to 1.5v) and high-end cooling. 5GHz-plus should also be possible with select chips and more exotic cooling.

We did some overclocking with a Core i7-3960X Extreme Edition processor and Cooler Master Hyper 212 cooler with the excellent UEFI utility on the Asus P9X79 Deluxe motherboard and were able to push our particular chip to 4.75GHz. We achieved that speed using a 125MHz BCLK strap and a peak all-core Turbo multiplier of 38 (125MHz x 38) with a peak voltage of 1.425v. At that speed and voltage, however, we were pushing the limits of the cooler—the processor would approach the 90 C mark after extended periods of sustained load, and at 91 C, SNB-E-based chips will begin to throttle.

With the processor overclocked to 4.75GHz, the Core i7-3960X Extreme Edition's Cinebench 11.5 score jumped from 10.51 (stock frequencies) to 13.99 (overclocked frequency), an increase of 33.1 percent. Not a bad performance boost for simply altering a few settings in our motherboard's UEFI utility.

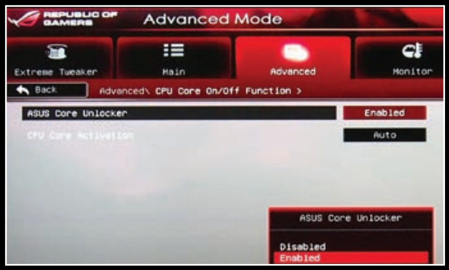


The UEFI utility on Asus' P9X79 Deluxe motherboard allowed us to take our Sandy Bridge-E based Core i7-3960X to 4.75GHz by altering only a few options in the Ai Tweaker menu.

lock those cores and turn cheap processors into something much more powerful.

Unlocking cores is very easy, provided you've got the right CPU and motherboard combo. Asus, Gigabyte, MSI, and other motherboard makers all offer Socket AM3/AM3+ boards with core unlocking capabilities (the boards require a SB7x0 or newer south bridge with Advanced Clock Calibration). As for the processors, many Phenom II X2, Phenom II X3, and Athlon II X3 chips are unlockable. Although not guaranteed, processors from newer batches should have no trouble being unlocked. If you've got one of these processors, do a quick search to see if others have had success with it—most likely they have.

To actually perform the unlock requires nothing more than entering the BIOS/UEFI, heading into the Advanced CPU configuration menu and enabling Core Unlocking or ACC (or whatever the motherboard manufacturer has called the setting). Keep in mind, though, should your chip unlock without incident, it may require increased cooling to deal with the additional active cores.



A simple flip of a switch within the Asus CrossHair V Formula motherboard's UEFI can unlock dormant cores on some AMD dual- and triple-core processors, resulting in significant multithreaded performance improvements.

MOD YOUR RADEON HD 6900 GPU'S COOLING

We have had the opportunity to evaluate a number of AMD Radeon HD 6900 series cards since their release. For the most part, the cards have been well-built and stellar overall performers. A small number, however, have suffered from minor cooling-related issues that can have an adverse effect on GPU temperatures. The issues have never caused any instability or major problems to speak of, but remedying them will lower operating temperatures, which in turn can result in a quieter, more overclockable card.

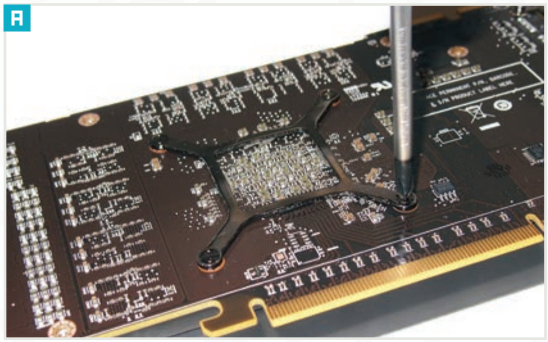
On the backside of reference Radeon HD 6900 series cards, there is a metal retention/spring plate that secures the GPU heatsink in place and applies constant pressure to ensure good contact with the chip. On occasion, that spring plate hasn't been fully tightened or was slightly bent to the point where it wasn't applying optimal pressure. While disassembling cards to fix the issue, we've also found that some Radeon HD 6900 series cards have had way too much thermal paste applied to their GPUs. Ideally, only a small amount of thermal interface material should be used to facilitate heat transfer from a chip to a heatsink; a paper-thin amount is all that is necessary. But on many of the Radeons we've disassembled, there has been so much thermal paste installed that more has oozed out from the sides of the GPU die than is actually necessary in the first place. And having too much thermal paste applied to a chip can actually hinder cooling performance.

To ensure that an affected Radeon HD 6900 series card is optimally cooled by the stock heatsink, there are a few steps you need to take.

1 DISASSEMBLE THE CARD To disassemble a reference Radeon HD 6900 series card, first remove all of the screws on the backside of the PCB that hold the rear stiffening plate in place, and then remove the plate. Then remove the two screws at the top of the case bracket above the MiniDP ports. Next, remove the four screws holding the heatsink's spring plate in place **(image A)**. At this point, gently rock the entire cooler assembly and pull it away from the PCB, being careful not to yank the wires for the fan out of their connector. Once the cooler is loose, unplug the fan connector and set the cooler aside. Be careful not to remove any of the sticky thermal pads on the memory chips.

2 RE-APPLY THERMAL PASTE With the card disassembled, you'll want to clean off the old thermal paste **(image B)**. Use some isopropyl alcohol (or other cleaner safe for electronic circuits) to carefully clean all of the stock thermal paste from the GPU and heatsink's base. Then apply a very thin layer of quality thermal paste to the GPU; the smallest amount necessary to cover the chip is all that should be used.

3 RE-ATTACH AND ADEQUATELY TIGHTEN SPRING PLATE Now the cooler can be reinstalled, but before re-attaching the spring plate make sure it is not bent or deformed in any way, and add a few thin shims to raise it slightly from the PCB and increase the spring pressure. Keep the shims very thin so as not to damage the GPU—we cut up an old rewards card from the supermarket. Stick the shims to the rubber pads on the underside of the spring plate **(image C)** and then put it in place and tighten the screws in a crisscross pattern. Then reinstall the backplate and you're ready to test.

A


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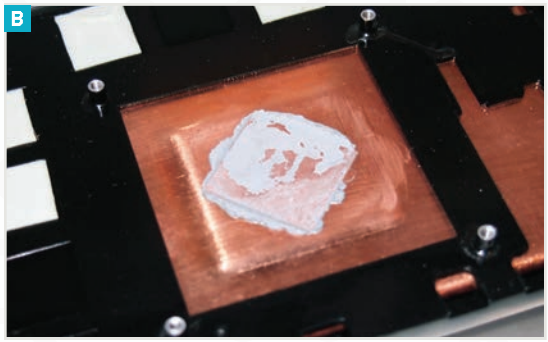

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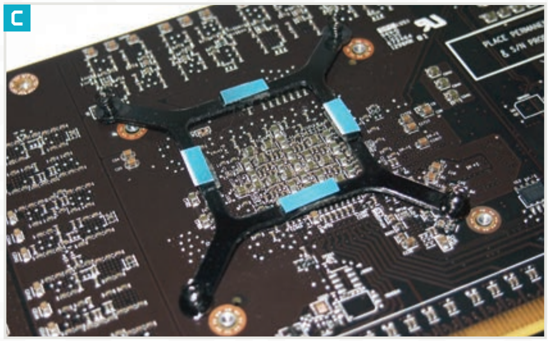
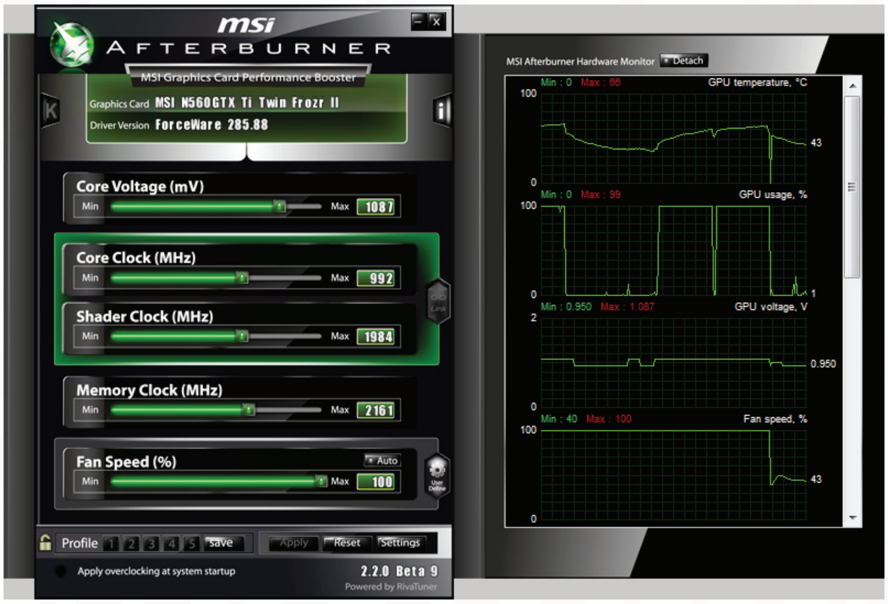


The cooling on our project card was definitely improved. Before touching it, the GPU on our 6970 idled at 44 C and peaked at about 82 C. After the mod, the GPU's idle temp remained steady at 41 C. Peak temps still hit 82 C because the cooler is throttled based on load, but it took somewhat longer to hit the peak, and the card seemed to cool down faster, too.

OVERCLOCK A GEFORCE GTX 560 TI

MSI's Afterburner GPU monitoring and performance-tuning utility can be used to tweak and overclock numerous graphics cards, not just those built by MSI.



Nvidia's GeForce GTX 560 Ti, which is based on the company's mainstream GF114 GPU, has proven to be quite a capable graphics card in its price segment. To prevent the card from being too fast and potentially encroaching on the more expensive GeForce GTX 570's territory, however, Nvidia had to delicately balance the 560 Ti's features and performance. The GeForce GTX 570 is powered by a pared-down version of the much more expensive GF110 GPU—to cannibalize its sales would be bad for Nvidia and its board partners, indeed.

With the right tools and a bit of experimenting, it's easily possible to significantly boost the performance of the more affordable GeForce GTX 560 Ti. The MSI Afterburner GPU tuning utility, for example, gives users the ability to not only overclock their GeForce GTX 560 Ti cards (and many other graphics cards, as well), but also alter fan speeds and GPU voltages for even more extreme overclocks.

To illustrate just how much performance is left under the GeForce GTX 560 Ti's hood, we grabbed MSI's already factory-overclocked GeForce GTX 560 Ti Twin Frozr II card and did some tweaking with Afterburner. The first steps in the process are obviously downloading and installing Afterburner. We recommend downloading the latest beta build available at bit.ly/3f5il3 to ensure the broadest compatibility. It wasn't until Afterburner v2.2.0 beta 9 that the 560 Ti was even supported, so if you've got a newer graphics card, using the latest beta is the way to go.

After downloading and installing Afterburner, launch it. A simple menu with a few sliders and hardware monitoring information will open. You could begin overclocking right away, but there are some hidden options that you need to enable in order to unlock the full potential of the app. At the lower corner of the main window, click the Settings button. A new window will open with a number of options available; tick the Unlock Voltage Control and Unlock Voltage Monitoring options and then click OK. Then close and re-open Afterburner and the voltage monitor and voltage control sliders should be available.

Our particular MSI GeForce GTX 560 Ti Twin Frozr II started with a core voltage of 1000mV, or 1v (although it was reported at .95v in the voltage monitor), an 880MHz GPU clock with 1,760MHz shaders and 2,100MHz GDDR5 memory. (The actual memory clock was 1,050MHz with an effective data rate of 4.2Gb/s. Afterburner reports DDR speeds.) Like a CPU, pumping more voltage into a GPU should allow for higher frequencies—within reason—provided the GPU has adequate cooling. Without modding a card's cooler, however, cranking up the voltage beyond about 5-9 percent isn't advisable. The Twin Frozr II cooler from MSI is fairly capable, though, and the card has a robust voltage regulator module, so we were confident we could push our particular card much further than stock.

Without tweaking our card's GPU core voltage, its GPU could hit 940MHz with decent stability. Increasing the GPU's core voltage to 1.087v, however, allowed us to push the GPU all the way up to 992MHz, an increase of 112MHz (12.7 percent) over stock and 170MHz (20.6 percent) over Nvidia's reference spec for the 560 Ti. Just for giggles, we also increased the memory clock to 2,161MHz, but didn't have much success beyond that number. The fan speed was maxed out to ensure the lowest possible temps.

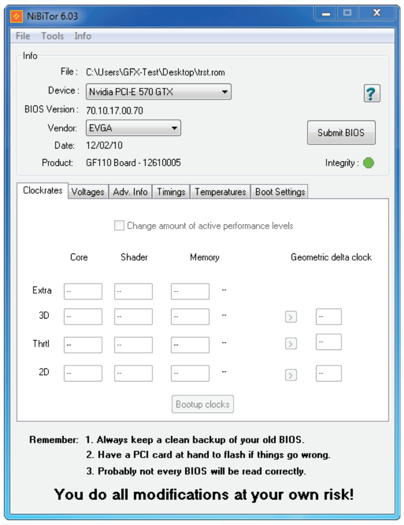
Our tweaking was well worth the effort. The stock MSI 560 Ti Twin Frozr II offered up 25fps and a score of 629 in the Unigine Heaven 2.5 benchmark and 32.2fps in Alien vs. Predator.* At its overclocked frequencies, though, the card managed 26.9fps and a score of 681 in Unigine Heaven and 34.6fps in AvP, increases of 8.2 percent and 7.5 percent, respectively. Not bad for doing little more than downloading a free utility and turning a few knobs.

* Benchmarks were run at 1920x1200 with 4xAA and maximum tessellation enabled.

" OVERCLOCKED, THE CARD SAW AN 8.2 PERCENT IMPROVEMENT IN UNIGINE HEAVEN

USE NIBITOR TO MOD A GEFORCE CARD'S BIOS

The Nvidia BIOS editor NiBiTor can be used to alter the BIOS settings on a wide array of GeForce graphics cards.



Although many GeForce-based graphics-card attributes can be altered using readily available applications, or even driver control panels, some hardcore modders prefer to edit a card's BIOS to eliminate the hassle of manually dialing in settings after updating drivers or moving a card from system to system.

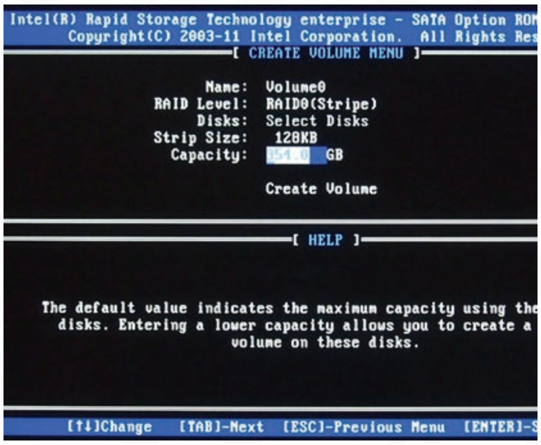
Modding a GeForce card's BIOS requires a few utilities, namely GPU-Z, NiBiTor, and NVFlash (all of which can be downloaded at www.mvktech.net and www.techpowerup.com). Technically, GPU-Z isn't an absolute necessity, but since NiBiTor has issues extracting BIOS files on some Windows 64-bit systems, GPU-Z can come in handy. GPU-Z is used to extract and save a card's original BIOS, NiBiTor to edit BIOS values, and NVFlash to flash the tweaked BIOS onto the card being modded. Before performing a GPU BIOS mod, a quick disclaimer is in order. A bad flash or incorrect setting can render a graphics card unusable. In the event of a problem, installing a second card in a system can be used to restore the other card, but tread lightly and only change values you're confident will work.

To mod a GeForce's BIOS, fire up GPU-Z and click the button next to the BIOS version listing to extract and save the card's original BIOS. Make a backup copy in case there's trouble later, and then open the original file in NiBiTor. If the GeForce in question is from the pre-Fermi days, frequencies, voltages, and other options can be changed easily right on the main window's various tabs. If you've got a Fermi-based GeForce, however, go to the Tools menu and choose Fermi Clocks and Fermi Voltages to alter either (min and max fan speeds can still be altered in the main interface). The frequency and voltage fields are rather cryptic for Fermi cards, though, so be sure to consult the oracle, i.e. Google, to know which to alter for your particular card, or try another utility called FermibiosCalculator (bit.ly/rqb29t) to go it alone.

Once you've got the BIOS values tweaked to your liking, save the BIOS file in NiBiTor, copy it to a bootable disk along with NVFlash, flash the modded BIOS to your card, and you're done.

AD

RAID SOLID-STATE DRIVES FOR PEAK PERFORMANCE



Configuring RAID on an Intel-based motherboard requires little more than entering the option ROM and working through some simple menus. AMD, Marvell, and other RAID controllers can be configured in a similar fashion, as well.

Solid-state drives are hot commodities for enthusiasts looking to squeeze every bit of performance from their systems. While even a single, midrange solid-state drive is a huge upgrade over a standard hard drive, RAID-ing two (or more) SSDs can result in truly extreme performance. A pair of modern SSDs running in RAID 0, for example, can silently offer upward of 1GB/s of read bandwidth, with similar writes and nearly nonexistent access latency. That's something no array of hard drives could even muster.

Configuring a group of solid-state drives in RAID is no different than doing the same with standard hard drives. We used an Intel X79 Express-based motherboard from Asus for this endeavor, but the process is similar for a wide range of boards and chipsets.

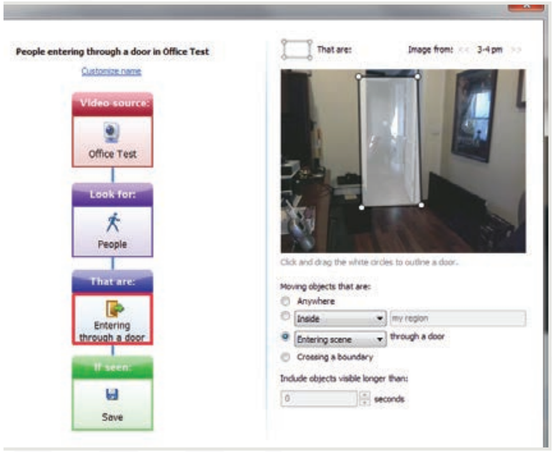
With the SSDs connected to the RAID-capable ports on your motherboard (or RAID controller card), power up the system and enter its BIOS or UEFI. Then head into the advanced configuration or integrated peripherals menu and find the SATA configuration option. Once there, set the SATA ports for RAID mode, then save the changes and exit the BIOS / UEFI.

On the next boot, you should see a prompt at some point after the POST in which you can enter the RAID configuration menu / option ROM (on our Intel-based system, we had to press Ctrl+I). Enter the option ROM and you'll see a handful of menu items. First you'll have to select the drives to include in the array and create the volume. Once created, you'll then have to give the volume a name and choose the RAID mode—we chose RAID 0 for its high-performance characteristics. Then you'll have to choose a stripe size (Intel recommends 128K for RAID 0) and finally set the total capacity of the RAID volume. Save the settings, exit the option ROM, and that's it.

Keep in mind that you'll also need to install the correct drivers for your OS to properly detect the array. And that Trim—an important feature of SSDs that helps maintain long-term performance—is not supported in RAID, but the idle garbage-collection algorithms available in newer SSDs will still work.

USE A WEBCAM AS A SECURITY CAMERA WITH OBJECT RECOGNITION

Boring video conferences and subpar facial recognition may have been the only jobs some webcams were good for, but



Vitamin D Video can transform a lowly webcam into a powerful security camera with object recognition.

when paired with the right software, a webcam can be transformed into a powerful security tool.

The process is straightforward, too. First, make sure your webcam is connected to your PC or network, its drivers are installed, and the cam is operational. Then download and install Vitamin D Video (www.vitamindinc.com). The app is free for single camera installations and is available for both Mac OS X and Windows.

Once you launch the app, a Camera Setup configuration wizard will open (if the wizard doesn't open, the configuration can be completed by accessing the Tools menu and selecting Add Camera). From the Camera Type drop-down choose your camera type (either Network IP camera, or USB / Built-In), and then from the Camera drop-down select the specific camera you'd like to use; then click Next. Vitamin D will test the camera connection. If all is well, click the Next button; if not, ensure that your webcam is working. On the subsequent screen, give the camera location a name (e.g., Office, Front Door, etc.), click Next again, and then click Finish to complete the initial phase of the setup process.

At this point, Vitamin D is capable of capturing video, but a few more tweaks will exploit some of the app's more powerful features. First, go to the Tools menu, select Options, and in the Options menu click the Move Video button to specify a directory other than the default option in which to save your videos. Then switch from the Preview pane to the Search pane by clicking the spyglass at the upper-left of the interface, and click the + button to define some rules. The app can track moving objects or specific shapes and distinguish between cars and people, for example, or even capture objects as they pass through specified thresholds. Once you've got your rules set up, switch on your camera in the app, and it'll capture video as long as the camera is connected.

SUPERCHARGE YOUR ANDROID SMARTPHONE

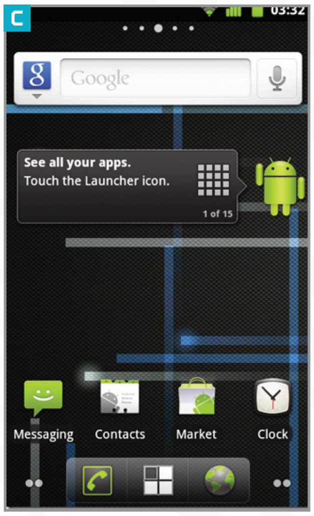
Over the last few years, as smartphones have gotten more powerful and prolific, wireless carriers have begun polluting them with more and more bloatware, not to mention abhorrent software like Carrier IQ. Perhaps it's the unwanted software or the common enthusiast trait of craving total control over our devices, but rooting or jailbreaking smartphones and flashing custom firmware, aka ROMs, has become increasingly more popular. Not only can flashing a smartphone with a custom ROM eliminate objectionable bloatware, it can also add new features (like Wi-Fi tethering), and potentially increase performance.

The process of flashing a custom ROM to a smartphone is far from universal. In fact, there can sometimes be multiple methods for flashing a single phone. But there are some common threads among the myriad devices. Usually, you'll have to obtain root access, somehow set the phone to accept downloads, use some sort of utility to flash a custom recovery image, and then from within the recovery image, flash the new ROM.

To demonstrate the process, we used a fairly new Samsung Galaxy S II i727 Skyrocket and an alpha build of the excellent CyanogenMod firmware (www.cyanogenmod.com). For specifics regarding your particular phone, we suggest perusing the forums at the smartphone-enthusiast website xda-developers (www.xda-developers.com), which has the goods on virtually all of the popular smartphones available.

1 GATHER FILES AND SET PHONE TO DOWNLOAD MODE To flash the SGSII Skyrocket, we first must grab all of the necessary files, which consist of Odin v1.85, USB drivers for the SGSII, the custom CWM recovery image, and the alpha build of CyanogenMod—all of which are linked in the Skyrocket subforum on the xda-developers site. With all of the files in hand, we next have to put our phone in download mode. To do so, we have to shut the phone off (remove and then reinsert the battery to be sure) and then hold down both the Volume Up and Volume Down buttons, while simultaneously plugging in its USB cable (the other end of which is plugged into a Windows 7 system). Once in download mode, we release the buttons and then hit the Volume Up button one more time to bypass an onscreen warning message and continue on. Next, we install the USB drivers for the phone and once the phone is properly detected by Windows, we fire up Odin. If your phone is in download mode and its drivers are correctly installed, Odin should identify a device on a virtual com port. Here, our Samsung Galaxy S II i727 Skyrocket is identified as device 0 on COM5 **(image A)**.

2 FLASH THE RECOVERY IMAGE With the proper drivers installed and the phone plugged in, Odin immediately recognizes the device and is ready to flash the new recovery image. Odin is capable of flashing bootloaders, recovery images, modems, and some carrier-specific files. For our purposes, we only need to flash the recovery image. To flash the recovery image, we tick the field in Odin labeled PDA and then browse to the CWM recovery image file we had downloaded. With the file selected, we click Start and Odin does the rest. A few moments later the recovery image with CWM is flashed to the phone **(image B)**.



3 FLASH THE CYANOGENMOD IMAGE With the CWM recovery image installed, we're ready to flash CyanogenMod. First, we power the phone off again and remove the phone's MicroSD card. We then copy the CyanogenMod image to the MicroSD card, reinsert it into the phone, and enter CWM by holding both the Volume Up and Volume Down buttons and simultaneously pressing and holding the power button until the Samsung logo flashes twice on screen. Once in CWM, we clear all of the phone's caches and user data, and follow the onscreen menus to select and flash the CyanogenMod image. Upon restarting the phone, we are done **(image C)**.

REPLACEMENT WI-FI ANTENNAS: THE REAL UPGRADE

Firmware tweaks and repositioning a wireless access point or router can only do so much to improve wireless performance and reception. To take wireless performance to the next level requires upgrading the router's antennas.

Wi-Fi antennas come in all shapes and sizes, from corner and window mounts, to elongated pole mounts, indoor and outdoor models, and simple replacement rubber-duckies. All of the antennas, however, will typically fall within one of two categories: directional or omnidirectional. The vast majority of antennas included with virtually all commercially available routers and access points (if it has external antennas) are omnidirectional, which is to say they transmit and receive wireless signals from all directions. Conversely, directional antennas better receive and focus transmitted signals in a single direction. Wi-Fi antennas will also carry some sort of dBi rating, which is a measure of the antenna's gain. Higher-gain antennas typically offer longer range and better performance over a given distance in comparison to lower-gain antennas.

Which antenna is best suited to a particular application will be determined by the environment and positioning of the router or AP. A centrally located router in a relatively open area that's servicing systems all around it, for example, would be best served by a high-gain omnidirectional antenna. A router sitting in the corner of a building, which has to transmit a signal to the opposite corner, would benefit from the focused signal of a directional antenna pointed in the proper direction.

Whichever antenna option is best for your setup, one thing is certain: Replacing the basic antennas that come included with most routers with high-gain alternatives will result in an immediate and noticeable improvement in signal quality and range, which ultimately improves performance, as well.

High-gain directional antennas are a surefire way to improve wireless performance, signal quality, and coverage.

OPTIMIZE WI-FI PERFORMANCE, RANGE, AND COVERAGE

We have explained how to install and use open-source firmware such as DD-WRT (www.dd-wrt.com) and Tomato (www.polarcloud.com) on wireless broadband routers on multiple occasions, so we won't go in-depth on the topic again here. Suffice it to say that using open-source firmware can enhance the performance and stability of a wireless network, enable a number of useful features, and give users a level of control that's unheard of with the stock, bare-bones firmware included with many routers.

Simply installing open-source firmware isn't enough to fully optimize your wireless connection, however. It's a key component to a fast, stable wireless network, yes. But there are changes to the default settings within the firmware and commonsense environmental tweaks you can make that all incrementally enhance overall performance. Within the advanced wireless configuration menus in DD-WRT, for example, there is a setting labeled TX Power, which alters the transmit power of the router. Increase the value in the TX Power field and—you guessed it—the router will transmit a stronger, farther-reaching signal. There are some caveats to altering the TX Power value, though. First off, increasing the value too much can fry the router's radio, so do some research to find the optimal value for your particular router. Although the default value (usually between 40mW and 71mW) may seem low when a maximum value of 251mW is available, cranking things up to the maximum is not advisable. Excessively high TX Power values can not only damage the router's radio, but will also introduce unwanted electrical noise and instability. We'd recommend increasing the TX Power by only a couple percentage points for a small boost in output. If you've got a device that sits on the fringe of your wireless network, a small bump in TX Power may be enough to rope it in with a stronger signal—provided its range isn't limited by its own capabilities.

Another firmware tweak to consider is disabling unneeded wireless modes. If all you've got are N-mode capable devices on the network, there's no need to enable B and G modes, which can drag down peak performance. We also recommend scanning your environment with a utility like inSSIDer (www.metageek.net) to see which wireless channel has the least amount of traffic, and configuring the router to use that channel.

Using a commonsense approach to your router's positioning can also have a huge impact on wireless performance. It's best to keep other wireless devices that may use similar frequency bands, like cordless phones, as far away from the router as possible to minimize the chance of interference. Microwave ovens are also notorious for interfering with Wi-Fi signals. Finally, if possible, position your router in as central a location as possible if you've got to service a large area. Most routers ship with omnidirectional antennas that transmit signals in all directions, so it's best to minimize the distance between the router and any devices that are going to connect to it. The ideal way to do that is to (obviously) make the router the central point between all of your wireless devices.

Open-source firmware like DD-WRT gives users the ability to boost the transmit power on many popular wireless routers, which can help increase their range.

STREAM PERSONAL MEDIA TO A ROKU

Roksbox gives users the ability to stream their own personal content to the Roku player, provided the files are stored on a network-accessible PC and are of the correct format.

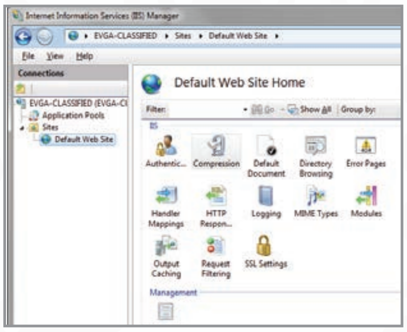
The various Roku set-top devices are some slick pieces of hardware. The diminutive boxes are affordable and allow users to stream a plethora of digital content. As cool as many of the channels on the Roku are, though, not being able to easily stream content from a home network out of the box is somewhat disappointing. Many of us have amassed huge collections of digital media, after all; being able to stream that media from our PCs to a TV with a sub-$100 box the size of a Klondike bar would be handy, indeed.

There is a way to stream personal files to a Roku, however. It's a bit of a pain to configure and costs a few bucks, but in the end it's worth it. By installing the Roksbox channel to your Roku (30 days free, $15 lifetime), strategically arranging your files with a specific directory structure, and setting up what's essentially a web server, Roksbox will allow you to "tune in" to your own personal channel.

Before we explain how to use Roksbox with your Roku, we're going to assume you've already got your device up and running and have an account registered on the Roku site. If so, head on over to the Roksbox site (www.roksbox.com) and click the link at the lower-left labeled "Add Roksbox Channel to Your Roku Player." You'll be taken to a new page and presented with a personalized URL that, when clicked, will take you to the Roku site and add the channel to your selections. Please note: It can take a few minutes (sometimes longer) for the channel to appear in your Roku's interface after being added, so be patient. Once the Roksbox channel is listed in your selections, go to the channel store on the Roku player and select Roksbox.

With the Roksbox channel installed, the next step is to organize your media with a folder structure Roksbox can handle. By default, the channel looks for videos, music, and image files in your Videos, Music, and Photos directories. Create a folder with any name you like (we chose D:\media\) on the machine that'll be serving the files. Inside it, create the Videos, Music, and Photos directories, and copy your media into the folders. Keep in mind, the Roku will only stream MP4 (H.264), MOV (H.264), and WMV/ASF (WMV9/VC-1) video files, AAC and MP3 audio, and JPG and PNG images. MKV files are supported only through the local USB port on the Roku.

The next step is to set up the web server. Windows 7 systems have IIS 7.5 built in; it just has to be enabled. If you prefer to use a different web server, Mongoose or Apache, for example, those will work, too. Our media was on a Windows machine, so we stuck with IIS. To enable IIS on Windows 7, click your Start button and type Windows Features into the search field. The Windows Features menu will open. In it, tick Internet Information Services and then tunnel down in the menu and also tick Basic Authentication. Then click OK and IIS will be installed. Note, if you have a firewall enabled, exclude IIS so traffic can pass through on port 80.



All of the web server's options can be configured through the IIS Manger utility, which is available under Administrative Tools after enabling the feature in Windows.

Next, head into Administrative Tools (go to Control Panel, then System and Security) and launch Internet Information Services (IIS) Manager. When the IIS menu opens, select Default Web Site from the Connections menu, and then click Advanced Settings in the Actions menu. In the window that opens, alter the Physical Path option so that it points to the directory where your media was copied and click OK. Then double-click Directory Browsing in the IIS window and enable it. Next, double-click MIME Types and add the MP4 extension, with the type "video/mpeg."

The last three steps are to enable Basic Authentication, disable Anonymous Authentication, and to create a user name with password (if you don't already have one) for login. Select Default Web Site from the Connections menu again and double-click Authentication; you can enable Basic Authentication and disable Anonymous Authentication from there. Once done, close IIS manager and create a new user account if necessary.

With the web server configured, head into the Roksbox settings on your Roku and point it to the IP address of your server. It'll ask for login credentials, and if all is well, you'll then be able to browse the files in the Videos, Music, and Photos directories and stream away. Should you run into any issues, there is an extensive step-by-step How To guide available on the Roksbox site.

AMD's Radeon HD 7970:

4.3 Billion Transistors of Pure Performance

BY LOYD CASE

AMD MOVES ITS HIGH-END GPU FAMILY TO 28NM, DELIVERING STUNNING PERFORMANCE AND IMPRESSIVE EFFICIENCY

WE KNEW THIS was coming. All the signs were there: the rumors, the price drops on existing videocards, and the tweaked versions of old standbys masquerading as "new" GPUs. But more than anything, it's been too long since we've had something fresh to sink our teeth into. And as has been the case in each of the last several big product launches, AMD is serving the first course.

Eric Demers, CTO of AMD's Graphics Division, began talking about the company's Graphics Core Next (GCN) earlier this summer. He described a new GPU architecture that would take graphics to the next level. He promised a GPU-compute monster that would remain highly scalable, so versions could be built into future generations of AMD APUs. The first iteration of Graphics Core Next comes in the form of the Radeon HD 7970, and it marks a substantial architectural shift for Radeon graphics. We'll examine the overall architecture first, and then we'll dive into the hardware specifics of the Radeon HD 7970.

RADEON
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GRAPHICS
AMD
RADEON

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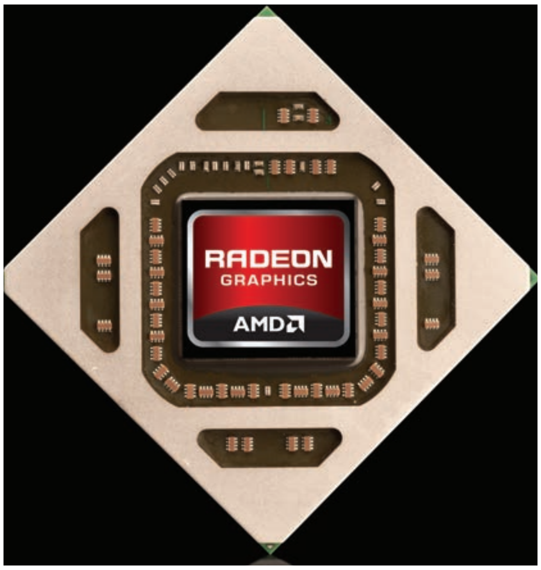
Tahiti is assembled from 32 GCN compute units, which translates to 2,048 stream processors, each of which is based on AMD's new SIMD-plus-scalar architecture.



GOODBYE VLIW

Previous AMD GPU generations used very long instruction words (VLIW), a way of tightly packing multiple GPU instructions in order to move them around the GPU and memory efficiently. VLIW went through a couple of tweaks, including a change to a four-word VLIW scheme from a five-word scheme. VLIW was well tuned for the modern generation of programmable graphics, but it wasn't so hot for GPU compute.

With AMD betting the farm on Fusion, which inherently takes advantage of a GPU's parallel-compute capability, the company needed a more flexible architecture. So AMD discarded VLIW in favor of something the company calls GCN Quad SIMD (single instruction, multiple data). Instead of a single VLIW instruction plus four math operations for the ALU (arithmetic logic unit), the GPU uses four SIMDs and a single ALU operation. The four SIMDs can do the same work as a single VLIW, but they can also act independently when needed.

GCN marks a major shift in how AMD GPUs operate, behaving more like a general-purpose vector processor than a pure graphics engine. What's more, each basic building block, called a GCN Compute Unit, includes a scalar coprocessor that can behave like a traditional—but non-pipelined—CPU. AMD has beefed up the caches that are distributed throughout the GPU. Each GCN core (yes, AMD is calling them cores) has its own dedicated L1 read/write cache. Each group of four cores shares a 16KB instruction cache and a 32KB scalar data cache. All the cores communicate over a shared bus to a partitioned L2 cache that can be sized differently depending on the graphics card and particular GPU die.

AMD intends for GCN to serve as the basis for several product families. The first product, code-named Tahiti, is aimed at gaming enthusiasts who want maximum frame rates while enabling maximum eye candy. The next product, code-named Pitcairn, will supersede the Radeon HD 6800 series. Pitcairn will be followed by a series code-named Cape Verde, which AMD believes will redefine the segment now held by products such as the Radeon HD 6700 series.

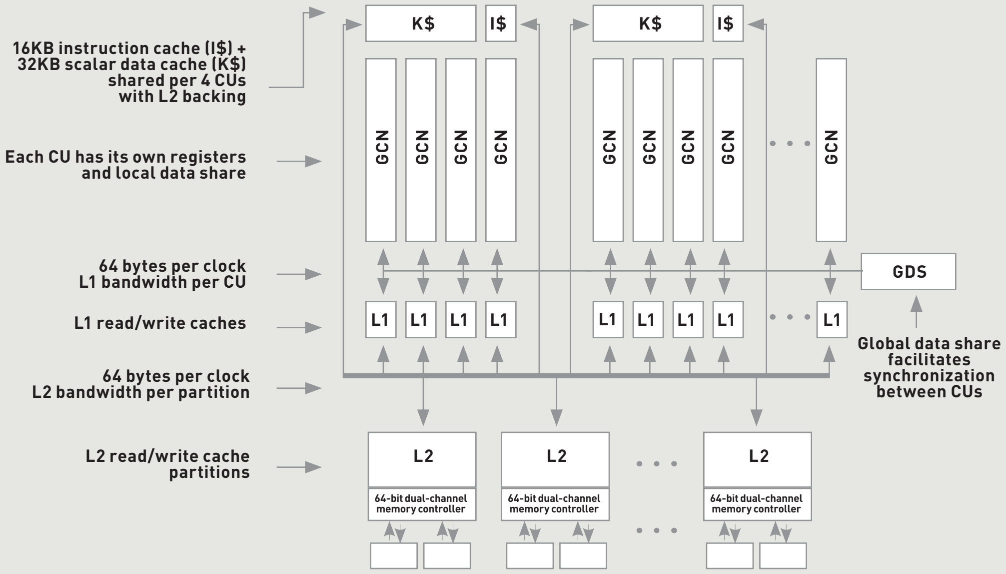
CODE NAME TAHITI

AMD took advantage of TSMC's new 28nm manufacturing process to build its new high-end GPU. The Radeon HD 7970 sports 4.3 billion transistors in a surprisingly small 365mm² die. AMD product marketing manager Devon Nekechuk tells us AMD's 28nm yields have been both "good" and "predictable."

Tahiti is assembled from 32 GCN compute units, which translates to 2,048 stream processors, each of which is based on AMD's new SIMD-plus-scalar architecture. The existing Radeon HD 6970, by contrast, is equipped with just 1,536 stream processors and doesn't benefit from the new architecture. The 7970 includes 768KB of L2 cache and eight render back-ends capable of pushing 32 color ROPs per clock and 128 Z/stencil ROPs per clock cycle. The existing 6970 provides the same quantity of render back-ends, but the newer card boasts higher throughput and much-improved efficiency; plus, the 7970 features a 384-

CACHE HIERARCHY

AMD's new Graphics Core Next architecture signals a major shift from building GPUs that are primarily for graphics as well as some compute chores, to building a high-performance parallel-processing engine that's capable of excellent compute performance without sacrificing graphics performance.



bit interface to 3GB GDDR5 memory and a PCIe 3.0 interface. The GPU is capable of peak throughput of 264GB/s.

Tahiti also implements a feature known as "partially resident textures." Local graphics memory is used as a kind of big cache for texture data, and very large textures can be streamed in on demand. This improves performance in game engines that use features such as virtual texturing or mega-textures: Texture sizes can be as large as 32TB (yes, terabytes).

The Radeon HD 6970 is oft criticized for its weak tessellation performance, especially when compared to Nvidia's GeForce GTX 580 series. AMD has beefed up the GCN's tessellator by improving the reuse of vertices, improving its off-chip buffering performance, and providing larger parameter caches. AMD predicts that overall tessellation performance will be as much as 4x better than on the 6970, depending on the application.

On the compute side, Tahiti uses dual asynchronous compute engines, which can independently schedule and dispatch work to improve multitasking. The compute engines can work in parallel with the graphics command processor, and AMD reports that context switching is "fast." The GPU also features dual built-in DMA engines, and AMD suggests the chip can saturate a PCIe 3.0 x16 bus when running compute chores.

Floating-point performance is fully IEEE compliant, and the 7970 is capable of pumping out up to 947 double-precision gigaflops per second. It is the first GPU to support OpenCL 1.2, DirectCompute 1.1, and C++ AMP in hardware.

Video processing has also been improved. Given the right application, Tahiti can evaluate 7.6 terapixels per second (peak), and it has the ability to transcode 1080p video in faster than real time.

SPECIFICATIONS

	Radeon HD 7970	Radeon HD 6970
Manufacturing Process	28nm	40nm
Transistor Count	4.31 billion	2.64 billion
Reference Core Clock	925MHz	880MHz
Frame Buffer	3GB GDDR5	2GB GDDR5
Memory Clock	1,375MHz	1,375MHz
Memory Data Rate	5.5 gigapixels/s	5.5 gigapixels/s
Memory Bandwidth	264GB/s	176GB/s
Memory Bus	384-bit	256-bit
Stream Processors	2,048	1,536
Compute Performance	3.79 single-precision TFLOPs	2.7 single-precision TFLOPs
Texture Units	128	96
Texture Fill Rate (peak)	118.4 gigatexels/s	84.5 gigatexels/s
ROPs	32	32
Z/Stencil	128	128
Maximum Board Power	250W	250W
Idle Power (active)	15W	20W
Idle Power (long dark)	3W	20W

THE RADEON HD 7970

Now that we've examined the GPU, let's take a look at a reference-design example of the first videocard that will use it. We'll start with power efficiency and noise, because AMD has made some notable advances on those fronts. The Radeon HD 6970 drew roughly 20 watts at idle, which was pretty good at the time. The Radeon HD 7970 card that AMD provided for this evaluation, which is outfitted with one 6-pin and one 8-pin PCIe power connector, idles at just 15 watts. AMD has also developed a new feature called ZeroPower that puts the card into a deeper sleep state—including turning off its cooling fan—when Windows shuts off your display. In this state, the card draws just three watts. ZeroPower delivers benefits when you're running two or more cards in CrossFireX mode, too. When your computer is simply running normal Windows stuff, the secondary cards will turn off their fans and reduce their power consumption to three watts, since they're not driving displays. That means a multi-GPU system at idle will consume nearly the same amount of power as a single-GPU rig.

In our tests, a machine equipped with a reference-design Radeon HD 7970 card, a six-core CPU, 16GB of RAM, and two hard drives consumed just 109 watts at idle. That power consumption is incredibly modest for a machine that powerful. The 7970 draws more power under load than one equipped with AMD's older high-end GPU, but it's still more conservative than Nvidia's maximum power consumption.

AMD will continue to use PowerTune technology to manage power consumption at all performance levels. One microcontroller monitors the thermal and power states of different parts of the card, and a second adjusts voltage and frequencies in real time. This allows AMD to set higher peak clock rates while remaining within the card's 250-watt TDP rating.

AMD has also re-engineered its reference-design cooling mechanism. The fan has larger blades, and all monitor connections are on one-half of the mounting bracket, leaving the entire other side free for ventilation slits. Based on our subjective evaluation, the 7970 card was substantially quieter than the 6970 card we compared it to.

EYEFINITY 2.0

AMD is improving its Eyefinity technology, and some of those changes will carry over to current-generation cards. One key feature that all Eyefinity-capable cards will get is better bezel compensation and new configurations, including 5x1 support (in either landscape or portrait configurations), which should make driving and flying games incredibly immersive. Maximum supported resolution over multiple displays will be beefed up to 16Kx16K. That, friends, is a lot of pixels.

AMD is also improving its stereoscopic 3D support, although it will continue to rely on third-party manufacturers to produce compatible glasses and displays. The Radeon HD 7970 will drive three displays in stereoscopic 3D mode using upcoming DisplayPort 3D monitors. Reference-design 7970 cards will be outfitted with one dual-link DVI, two Mini DisplayPort, and one HDMI 1.4a. They'll support up to six displays simultaneously, although you'll need the right mix of adapters to do that.

AMD's new Discrete Digital Multi-Point Audio (DDMA) is another interesting feature, which could be useful in online gaming, video-conferencing, and other situations. If you're engaged in a video conference with several other participants displayed on discrete monitors equipped with speakers, it will enable di-

With dual-link DVI, HDMI 1.4a, and two MiniDP ports, the reference design HD 7970 can run six monitors at once, with the right adapters.

rectional audio, so that when a participant on a monitor to your left speaks, you'll hear his or her voice on that left-hand monitor. AMD says DDMA will also be useful for multiroom audio setups, so you can play a game on the computer in one room while music is piped into speakers in other rooms in the home.

THE PERFORMANCE PICTURE

We tested a reference-design Radeon HD 7970 card using beta drivers, so bear in mind that our benchmarks are based on a work in progress. This card did not, however, come with the telltale EMI warning labels that typically mark early engineering samples. We did encounter one glitch, although it happened only once during testing, and we were unable to replicate it: When we cold-booted the system, the GPU's clock reset to 500MHz (instead of the usual 925MHz). We used AMD's OverDrive feature, part of the Catalyst control panel, to reset the clock to the factory default.

We compared the 7970 to three other cards: an XFX Radeon HD 6970, running at 880MHz and paired with 2GB of GDDR5; an EVGA GTX 580 SC, which is slightly overclocked at the factory to 797MHz and is outfitted with 1.5GB of GDDR5 memory; and an aggressively overclocked (855MHz) EVGA GTX 580 Classified, which is equipped with 3GB of GDDR5. Unlike our standard tests, we brought the pain by benchmarking all four cards on a 30-inch display at 2560x1600 resolution, 4x AA, and all settings at their maximum values.

When the smoke had cleared, the two GTX 580 cards won just a single benchmark, the HAWX 2 test, which tessellates just about everything in sight. There were a few effective ties between the 7970 and the EVGA Classified, including Metro 2033 and Just Cause 2; but when the 7970 won, it generally won big. It opened a substantial lead on the Unigine Heaven synthetic test, for instance, even when we cranked tessellation to "extreme."

AMD suggests that the Radeon HD 7970 has some clock-speed headroom, so we can expect to see factory-overclocked cards pushing the core clock rate up to 1GHz, and possibly higher. That 3GB of frame buffer will come in handy for GPU-compute applications. AMD expects retail cards based on the 7970 to sell for $550, which strikes us as a reasonable—but not exceptional—value. AMD will also ship a cost-reduced version of the 7970, in the form of the Radeon HD 7950, in early 2012, but the company hasn't released specs or pricing on that SKU. ⏻

BENCHMARKS

	AMD Radeon HD 7970 Reference	XFX Radeon HD 6970	EVGA GTX 580 SC	EVGA GTX 580 Classified
3DMark 2011 Perf	**7,985**	5,750	6,747	7,321
3DMark Vantage Perf	**31,873**	24,453	26,936	28,559
Unigine Heaven 2.5 (fps)	**28**	17	22	23
Shogun 2 (fps)	**28**	19	22	24
Far Cry 2 / Long (fps)	**96**	75	85	92
HAWX 2 DX11 (fps)	113	73	120	**128**
STALKER: CoP DX11 (fps)	**37**	25	28	29
Just Cause 2 (fps)	**48**	31	41	**48**
Batman: Arkham City (fps)	**51**	36	45	47
Metro 2033 (fps)	**17**	14	15	**17**
Dirt3 (fps)	**60**	44	50	55
Core / Memory Clock Speeds	925 / 1375	880 / 1375	797 / 1013	855 / 1053
System Power at idle (watts)	**124**	126	140	140
System Power at full throttle (watts)	325*	**296**	344	385
Price	$550	$350	$550	$600

Best scores are bolded. Our test bed is a 3.33GHz Core i7 3960X Extreme Edition in an Asus P979X Deluxe motherboard with 16GB of Corsair DDR3/1600 and an AX1200 Corsair PSU. The OS is 64-bit Windows Ultimate. All games are run at 2560x1600 with 4x AA, except for the 3DMark tests. *"Long dark" system power was 109W.

MAXIMUMPC 2011 GAMING AWARDS

AND THE WINNERS ARE …

YES, A YEAR HAS PASSED since we last feted our favorite pastime—PC gaming. In some ways it feels like it's been much longer, so rich was the quantity and quality of titles that PC gamers had to choose from. That abundance served to make our job as awarders especially challenging. Nevertheless, we holed up in an office as we do every year and collectively reviewed the highlights and lowlights of the last year in PC gaming. Now it's time for you to kick back and enjoy the spectacle that is Maximum PC's 2011 Gaming Awards!

With an arrow to the heart, gamers everywhere have fallen head over heels for Bethesda's latest open-world masterpiece. **SKYRIM**

GAME OF THE YEAR 2011

THE ELDER SCROLLS V: SKYRIM

It's exceptionally rare these days that a single-player game so thoroughly dominates the gaming zeitgeist. But with an arrow to the heart (and in the knee), gamers everywhere have fallen head over heels for Bethesda's latest open-world masterpiece, The Elder Scrolls V: Skyrim.

Skyrim has a bit of something for everyone. You can live out your virtual Viking fantasies, wandering the pine forests, windswept plains, and snowy peaks, hacking through any beast or bandit that crosses your path. You can walk the arcane corridors of magic, bending fire and lightning to your will. You can stalk the shadows, picking pockets, looting chests, and slitting throats. Or, better yet, you can do all of these things, as *you* create the character and the story you want. Oh, and there are dragons.

www.elderscrolls.com, **ESRB: M**

The Enhanced Interrogation Award

L.A. NOIRE

We're not sure whether to trust Rockstar Games, doubt its sincerity, or flat-out call it a bait-and-switch artist. You see, the publisher delivered its usual polished cinematic experience—what it didn't tell us is that L.A. Noire is more an interactive movie than an actual video game.

Still, the game's well-written script, fantastic production values, and innovative facial motion-capture technology make it more fun than ever to accuse a grieving widow of being a liar, a murderer, or a whore—or in true Noir fashion, all three. www.rockstargames.com, **ESRB: M**

Most Succulent Game

BULLETSTORM

When you're playing a game where you can kick people into the air, fill them with bullets in slow motion, and then watch as they cascade off a cliff or into large, conveniently placed cactuses, well, you've got a winner. Aside from introducing mind-blowing FPS gameplay mechanics, Bulletstorm also features some of the most movie-like experiences we've ever seen in its phenomenal single-player campaign. Solid voice acting, amazing graphics, a ridiculous story, and points for shooting enemies in the ass (literally), Bulletstorm is zany, bloody, chaotic fun. www.bulletstorm.com, **ESRB: M**

L.A. Noire is more an interactive movie than an actual video game. **L.A. NOIRE**

The Stretching the Bounds of Physics and Friendship Award

PORTAL 2

Portal won our hearts with its mix of clever physics puzzles, laugh-out-loud humor, and poignant storytelling. Portal 2 is a dazzling repeat performance, with new types of brain-twisting puzzles and an even better story. The game's co-op mode, instead of dropping another Chell into the single-player campaign, is an entirely new series of test chambers featuring two boisterous robots, and cooperation is key—you don't want to get on GLaDOS's bad side. www.thinkwithportals.com, **ESRB: E**

The Non Sequitur Award

DEUS EX: HUMAN REVOLUTION

Human Revolution, like the original Deus Ex, gives the player many different paths to success. You can choose to be a hulked-out combat specialist, a hacker, a stealth character, or anything in between. There's no wrong way to play Human Revolution—until you come to a boss battle. The boss battles are brainless, out-of-nowhere inclusions that completely change the tone of the game, and put non-combat characters at a severe disadvantage. We never asked for this. www.deusex.com, **ESRB: M**

The Worst Vacation Package Ever Award

DEAD ISLAND

If the Banoi tourism brochure had said "Dead Island," we probably would have just gone to Disneyworld instead. Sun, sand, waves… and waves of zombie hordes—what Dead Island lacks in amenities, it makes up for in hands-on service that appreciates you for your brains. But hey, at least when comparing terrible vacation stories, our head-stomping weekend stopover at Dead Island will beat the hell out of our buddy's sob story about stepping on a jellyfish and forgetting his passport at the hotel. www.deadislandgame.com, **ESRB: M**

The Figuratively Jumping the Shark Award

ASSASSIN'S CREED: REVELATIONS

It's hard to tell exactly when a series that features glowing alien demigods and a millennia-spanning conspiracy theory involving everyone from Da Vinci, to Hitler, to Gandhi, to Adam and Eve "jumps the shark." Until, that is, we realized it's not the game's plot, but developer Ubisoft who has gone off the deep end.

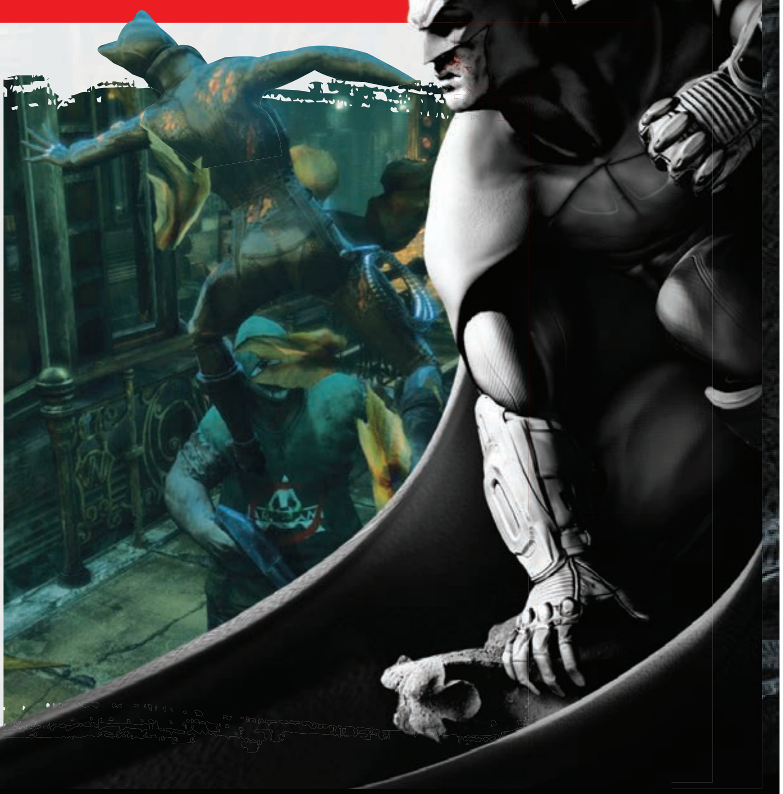
Revelations is actually a solid game, but being the third Assassin's Creed game in as many years, the experience is starting to feel a bit like Ezio: old and tired. bit.ly/sM0VGV, **ESRB: M**

An incredible game with one of the darkest and most shocking story lines. **BATMAN: ARKHAM CITY**

The Literally Jumping over Sharks Award

BATMAN: ARKHAM CITY

Batman can knock out anyone, including sharks. This was evidenced in Batman: Arkham City, where in one of our favorite sections of the epic game, you must literally tread thin ice—walk too fast or become impatient, and a massive great white shark shoots out and attacks the caped crusader. That's award-worthy in and of itself, really. Shark-punching aside, Arkham City is an incredible game with one of the darkest and most shocking story lines we've had the pleasure of experiencing since, well, Arkham Asylum (our 2009 game of the year). www.rocksteadyltd.com, **ESRB: T**



The Kid Walks into Magazine, Wins Award

BASTION

The Kid wakes up, blinks his eyes in confusion, and looks around. Sees a sign on the wall: Maximum PC. Kid remembers the old world, remembers magazines and the stories they told. He finds himself surrounded by a bunch of editors—good folk, simple folk. They begin to tell him a tale, a tale he knows all too well.

Kid listens as they praise his journey, tell him he's damn fine with a pistol and a hammer. Tell him his world is bright and vibrant and beautiful. Kid tears up a little, feels a lump swelling in his throat, manages to croak out a single word... "Thanks."

www.supergiantgames.com, **ESRB: E10+**

The Third Best Game in Which America is Invaded

HOMEFRONT

This lusciously vivid FPS depicts urban and suburban America as a guerilla resistance battleground after a unified Korean invasion in 2025. Now that "contemporary god" Kim Jong Il has croaked (step 1 of the lead-up to the game), time will only tell if this far-fetched premise will play out. We know one thing for sure, though: Homefront's janky gameplay and stunningly short campaign had us pining for New York's obliteration, either in Modern Warfare 3 or Crysis 2.

www.homefront-game.com, **ESRB: M**

The These Boots Are Made for Stomping Award

DEAD SPACE 2

There's a lot to love about Dead Space 2. There's the creepy, claustrophobic atmosphere, the tense sound effects, the horrific enemy design, and a ton more. What really sets the game apart, however, is the sheer, visceral carnage you can unleash with each of the game's many upgradable weapons. But even if you're out of ammo for your saw-blade launcher, you're not defenseless—there's always Isaac's torso-smashing stomp, which will go down in history as gaming's most grisly looting animation.

www.deadspace.ea.com, **ESRB: M**

It isn't funny (purposely, anyway) and the gameplay is shockingly infantile. **DUKE NUKEM: FOREVER**

The Everyone Saw this Coming Award

DUKE NUKEM: FOREVER

Look, we wanted Duke Nukem: Forever to be good. All of us did, collectively. But Duke Nukem: Forever is, in so many ways, just a bad game. It isn't funny (purposely, anyway) and the gameplay is shockingly infantile, but the fact that it's terrible isn't really all that shocking. When a game is stuck in development hell for more than a decade, something'll emerge, sure, but it ain't gonna be pretty. Duke Nukem: Forever proves that.

www.dukenukem.com, **ESRB: M**

The Witchiest Game of 2011

THE WITCHER 2: ASSASSINS OF KINGS

Geralt of Rivia returns with a vengeance in one of the most gorgeous and gritty games of 2011. As in the first game, your choices matter—the game's second act is completely different, depending which side you take in a certain conflict. The Witcher 2 isn't perfect—the learning curve is steep and parts of the game are frustrating in the extreme, but it was still one best RPGs of the year—and certainly the witchiest. Bonus: The game was released completely DRM-free and still sold over 1 million copies.
www.thewitcher.com, **ESRB: M**

The Play with the Lights on Award

AMNESIA: THE DARK DESCENT

Amnesia: The Dark Descent is dark. It's got dark right in the title. It's dark and atmospheric and, at times, genuinely terrifying. And did we mention it's really dark? The loading screen recommends you turn off the lights and plug in some headphones to better appreciate the frightening atmosphere. We, however, suggest otherwise. Turn on all the lights, invite over your neighbors, crank up the stereo—you'll thank us when you're blissfully dreaming of videocards and motherboards and not having horrifying Lovecraftian imagery dominate your nightmares.
www.amnesiagame.com, **ESRB: M**

The Too Accessible Award

CRYSIS 2

Crysis 2 looks good, but it's not the brutal benchmark we've coveted for years now. In fact, it was developed primarily as a console game, and, while beautiful, it surely doesn't require the hardware needed to top out its little, more graphically demanding brother, Crysis 1. Regardless, Crysis 2 is a damn fine sequel that's gorgeous, challenging, and engrossing from beginning to end.
www.ea.com/crysis-2, **ESRB: M**

A damn fine sequel that's gorgeous, challenging, and engrossing from beginning to end. **CRYSIS 2**

Best Use of Color

LIMBO

A freaky-genius masterpiece of a puzzle game, Limbo is an exercise in minimalism unlike anything we've played before. The game's side-scrolling adventures follow a nameless boy as he searches for his sister in a creepy monochromatic underworld. You will fail him. He will die. Horribly. And often. It's gruesome to constantly watch the boy beheaded, dismembered, impaled, and crushed, but in Limbo, dying is just trial-and-error for the next challenge. Using elements of dark and light, shadow, and a complete lack of dialogue, text, or explanation, Limbo creates an intensely eerie atmosphere throughout. http://limbogame.org/, **ESRB: T**

The Tanks for Nothing Award

WORLD OF TANKS

Free to play (aka F2P) games have inspired a lot of anxiety among hardcore gamers. They worry that the game will be an incessant grind, like many Korean F2P MMOs, or that players who pay cash money will have an insurmountable advantage over those who don't (à la Battlefield Heroes). Fortunately, there are a few games around, like World of Tanks, which prove you can get a great, action-packed multiplayer game for free, and that free-to-play doesn't have to mean pay-to-win. www.worldoftanks.com, **ESRB: T**

A freaky-genius masterpiece unlike anything we've played before. **LIMBO**

The Most Creative DRM Award

SERIOUS SAM 3

We're not big fans of DRM, but we respect that a game developer has to go to some lengths to protect its work from illegal downloading. We respect it even more when that developer trolls software pirates with an immortal pink scorpion. That's what Croteam did with Serious Sam 3—if you pirate the game, be prepared to go toe-to-toe with a gun toting, lightning-fast arachnid. www.serioussam.com, **ESRB: M**

Worst Battlefield Sequel

MODERN WARFARE 3

We're big Call of Duty fans, but Modern Warfare 3 feels a bit stale, especially when placed next to the revolutionary Battlefield 3, which released around the same time. We understand that if you know what works, stick with it, but innovation is important, too. Activision, please update the graphics engine and take some chances next time around! We're careening into a crazy-ass era of gaming, and we simply want Call of Duty to catch up. www.callofduty.com/mw3, **ESRB: M**

THE ROGUE-LIKES GALLERY

The roguelike—a dungeon-crawler with randomly generated levels, ultra-hard difficulty, and permadeath—is one of the most venerable of game genres. Traditionally crafted with ASCII graphics, roguelikes were the direct precursors to action RPGs like Diablo. That doesn't mean the genre is dead, though—2011 was a banner year for roguelikes. And roguelike-likes.

DUNGEONS OF DAEDMOA

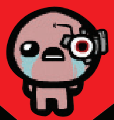
Permadeath? Check. Randomly generated levels? Very check. Lutefisk? Scads of it. Dungeons of Dredmor takes the staples of the roguelike genre, and adds a bunch of skillsets like Mathomancy, Viking Wizardry, and Necronomiconomics, as well as graphics reminiscent of '90s LucasArts adventure games.
www.dungeonsofdredmor.com, **ESRB: NR**

DESKTOP DUNGEONS

An alpha version of Desktop Dungeons appeared in 2010 as a single-level roguelike that could be played in 15 minutes. The game isn't officially out yet, but, as is the current practice, you can play the beta version now if you preorder the game.
www.desktopdungeons.net, **ESRB: NR**

THE BINDING OF ISAAC

From Edmund McMillen (Super Meat Boy), this is a roguelike with a demented aesthetic, featuring a bawling baby, Biblical themes, and poop! As Isaac, trying to escape the aforementioned Binding (it's a bad thing), you defeat your enemies by spraying them with your tears.
bit.ly/oWF7bP, **ESRB: NR**



Best Multiplayer Game

BATTLEFIELD 3

Battlefield 3 is about as epic a first-person shooter as we've seen in a hell of a long time. Unlike some hyped shooters that offer limited vehicle support, BF3's vehicles give the game a three-dimensional battle space that has to be experienced to be appreciated. Not only are you worried about some frakking sniper, you also have to contend with attack helicopters, jets, tanks, APCs, and the other 63 players, too. And all in stunning graphical detail that pushes the PC to its limits.
www.battlefield.com, **ESRB: M**

FIREARMS: THE REAL DEAL

WE ASK A NAVY SEAL ABOUT THE AUTHENTICITY OF VIDEO GAME WEAPONRY

Craig "Sawman" Sawyer

Video games, like movies, are more about entertainment than realism. Yet game developers spend an inordinate amount of time modeling weapons, recording the sound from actual weapon systems, and calculating how much damage a bullet should do. Since firearms are such a big part of first-person shooters, we wanted to get the lowdown on the current state of firearms in video games and how they rate in real life.

To get the view of an expert, *Maximum PC* spoke with Craig "Sawman" Sawyer. Sawyer started his tactical life with the Marine Corp before moving to the Navy SEALS with SEAL Team One and DEVGRU. Sawyer has fired everything from pistols to belt-fed weapons and rockets.

MPC: Modern games have shifted to highly customized loadouts for equipment and weapons. In reality, how much flexibility do individuals or units really have when selecting their own weapons and how many "pieces of flair" they can put on them?

Sawman: In the ranks of the conventional military, a soldier carries what he's told to. In the smaller, more specialized units, there's much more individual choice. A SEAL Operator can pretty much carry what he wants to for a particular mission, but the needs of the team or squad play heavily in that decision. It's the working of the different weapons in concert that really makes a small squad effective. If a small team is well-coordinated, they can have the effect of a much larger unit.

MPC: Video game weapons often only have one setting: full auto. Is full auto really used that often? What would the proper application for automatic fire be in reality?

Sawman: I only use full auto with small sub-machine guns and heavy belt-fed machine guns. With everything else, I'm running and placing single shots on target as rapidly as necessary to effectively engage each target and eliminate the threats at hand. With a real weapon, especially those with significant recoil, full auto isn't very effective, because the weapon rises so quickly under full auto fire that only the first couple rounds can be brought to bear on the target. All rounds after that go high and are a waste. That's why when we do use full auto, we use controlled bursts, with the length of the burst being applicable to the weapon being fired. Some weapons can be fired effectively with long bursts, like the FN P90, and some, like the MK 48, require much shorter bursts to keep the majority of each burst on target.

MPC: Are there times when you really would carry a carbine or SMG, a rifle, plus a sidearm?

Sawman: Actually, yes. I have on several occasions. As an example, when I was bringing a bolt action .50 cal Sniper Rifle onto a target to bring precision fire on certain predesignated targets, I also had to bring a weapon I could fight with, in order to be effective during contact on the way in or out. Because we always like to carry pistols as a last-ditch, Evasion & Escape weapon, or backup, I had that on, as well. So, yes, it gets cumbersome. I weighed 325 pounds lifting off for one particular mission, and I didn't even have a ruck!

MPC: Flashbang or stun grenades are pretty popular in games today. What's it like getting flashbanged?

Sawman: Being "crashed" is like being blinded, deafened, and punched in the nose all at the same instant. Only those closest to the device when it goes off are completely affected. The others farther away experience somewhat less effect, depending on distance. A flashbang, or "crash" is only a tool, just like any other. It is not a miracle worker, but in the hands of trained professionals, it can be applied with deadly effectiveness.

MPC: Guns Akimbo, or dual pistols, is another favorite video game practice. Would you ever dual-wield pistols?

Sawman: No, I would not. The reason is that I can shoot more quickly and more accurately with both hands controlling the recoil of one pistol at a time.

MPC: The most favored pistol in video games is a nickel-plated Desert Eagle, or Deagle, in .50 Action Express. Would such a heavy pistol (or HK's massive MK23) ever play a role in combat?

Sawman: Yes, but not as a backup sidearm. A huge pistol like the SOCOM HK 23 is best utilized as a primary for very specialized applications when a long gun is inappropriate.

MPC: Suppressors are gaining popularity in video games. How prevalent are they in actual operations?

Sawman: In conventional units, suppressors still aren't used as much as I would expect. I mainly see them on certain sniper systems. In the Special Operations community, however, suppressors are used extensively to cut down on the noise signature, thereby minimizing the likelihood of activating an enemy reaction force, and reducing muzzle flash at night, which reduces your visual signature and the amount of return fire you get. Nobody wants to be signaling their position as an aiming point during a night fight. Suppressors help in that regard.

Check out our full interview with Sawyer at bit.ly/sNWAhB.

Despite its popularity in video games, the gold or chromed Desert Eagle, aka Deagle, in .50 caliber is not a practical backup weapon in combat.

WHITE PAP

BY BILL O'BRIEN

Phase-change Memory

PRAM could one day replace not just flash memory, but DRAM as well

While we look to move data we once stored on our local hard drive to the cloud, there's also a movement afoot to find a replacement for DRAM. The buzz right now revolves around phase-change memory (PRAM), a nonvolatile memory type that's also being eyed as a replacement for flash memory.

PRAM RIDES AGAIN

Like most breakthrough technologies, phase-change memory isn't really new. Scientists first explored the use of chalcogenide glass as a memory technology back in the 1960s; and a chalcogenide film with a diode array was described and demonstrated as a feasible phase-change memory device in the early 1970s. A chalcogenide (pronounced kalko-genide) is a binary compound consisting of a chalcogen (any of the elements oxygen, sulfur, selenium, or—in this case—tellurium) and a more electropositive element (meaning an element that has a tendency to release electrons). Chalcogenides are also used in rewritable optical media, such as CD-RW or DVD-RW; but in those scenarios, the material's optical properties are manipulated rather than its electrical resistivity (more on that later).

A shortage of high-quality raw material, excessive power consumption, data corruption issues, and relatively low switching times (in the 100ns range) prevented the technology from gaining any real traction back then. DRAM production technology had also improved by this time, rendering it less expensive and easier to manufacture. These days, however, the same production techniques that made DRAM a winner back then are making it difficult for that technology to continue improving today. Theoretically, you can build a circuit on the atomic level, but the lithography that's used to produce a DRAM die can shrink only so far.

In 2006, Samsung filed a patent application for a production technology that reduces PRAM's switching time from 100ns to just 5ns. While that's still not as fast as a volatile memory such as DRAM (which can switch states in just 2ns), it comes very close. IBM announced a breakthrough of its own in mid-2011: PRAM chips capable of storing two bits of data per cell without experiencing data corruption.

Unlike the NAND flash so common today, PRAM does not require an erase-write cycle (the two-step process during which existing data must be marked for deletion prior to new data being written in the same space). That erase-write cycle not only slows NAND flash performance, it also limits its lifespan as each burst of voltage degrades the memory: Typical consumer NAND storage devices are limited to between 5,000 and 10,000 write cycles, while enterprise-class products can withstand up to 100,000 write cycles. IBM claims its PRAM can achieve as many as 5 million write cycles before it clasps its chest and totters over dead.

HOW PRAM WORKS

Phase-change memory exploits the differences in a material's electrical resistance as it changes phases, from hot to cold, for instance, or from a liquid to a solid. The material must also be capable of reversing these phases (e.g., going from hot to cold and then back to hot again). Each binary phase can represent on or off, open or closed, yes or no, and so on. Most PRAM research is focused on using a chalcogenide alloy of germanium, antimony, and tellurium (GeSbTe), commonly referred to as GST. GST can exist in either an amorphous (RESET) phase or—when heated—in a crystalline (SET) phase. In its amorphous, glass-like phase, the material is disordered and exhibits a high degree of resistivity. The situation is reversed in its crystalline phase, where the material forms a highly ordered lattice that exhibits very little resistance.

A PRAM cell is created by sandwiching a layer of GST between two electrodes. A resistive heating element extends from the top electrode into the chalcogenide material. When a current is injected into the junction, the GST switches from its amorphous phase (representing a binary 0) to its crystalline phase (representing a binary 1).

As with all memory structures, PRAM isn't limited to single-block architecture. It can also be organized into bank/block structures, just like conventional DRAM. IBM has developed a technique to store binary 00, 01, 10, and 11 values in four resistance layers of a single bit. Combine this with its ability to store more than one bit per cell, and you get a huge leap in the capacity and performance of memory. PRAM's scaling ability reinforces Moore's Law, which predicts computer hardware will see exponential improvements for the foreseeable future.

PRAM APPLICATIONS

You'll need to wait a while before you can include PRAM in your own build. Manufacturers will look to recover their significant R&D costs by selling the tech-

ER

> “UNLIKE NAND FLASH, PRAM DOES NOT REQUIRE AN ERASE-WRITE CYCLE

nology to the enterprise long before they expand into the price-conscious consumer market. Moving least-accessed data records to nonvolatile memory will enable large corporations to reduce the number of hard drives in their servers, which will trim their maintenance and power costs.

This benefit will likely extend to cloud servers, too. In a large database environment, the key data for a record could be loaded in DRAM, while a much larger collection of ancillary data for the same record could reside in PRAM. With the much larger capacity of PRAM acting as a repository for that ancillary data, the database application would be able to access the primary segments of a much larger number of records without overloading system memory.

But don’t write off the desktop yet. Although DRAM will continue to be the memory closest to the CPU for quite some time, PRAM could serve several other functions, including being an immediate boot tool. It can be so much denser than DRAM, so it would be able to contain much more than just your boot environment. How would you like to have all your applications and their respective data instantly available the moment you power up? And since PRAM is nonvolatile, it won’t leach power from portable devices such as notebooks, tablets, and smartphones while they’re ostensibly “off.”

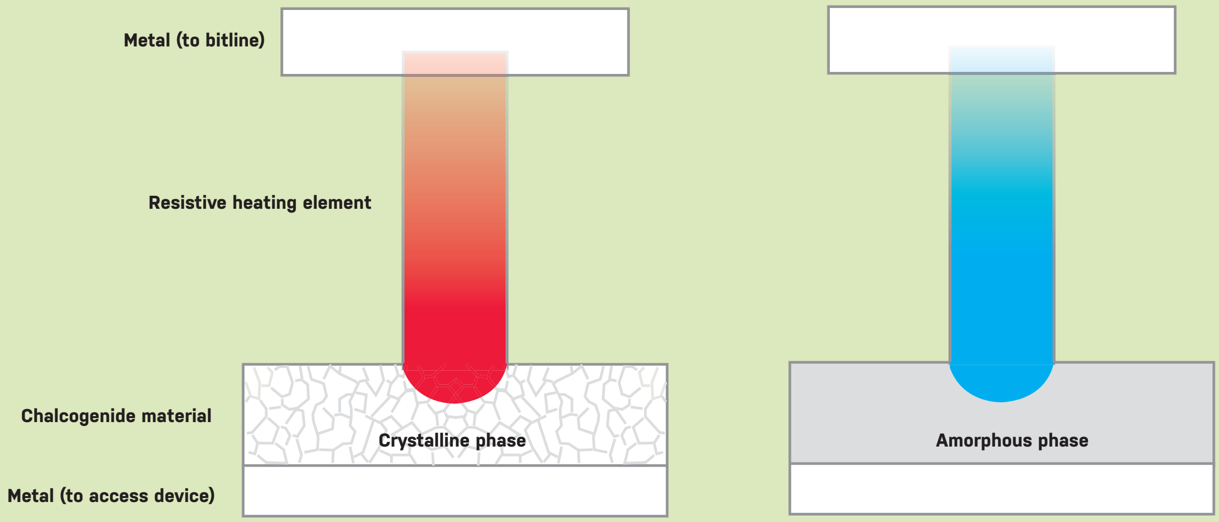
THIS AIN’T NO BUBBLE

PRAM appears to be on track for real commercial and mainstream applications over the next five years. Unlike a similar alternative from the ’70s, bubble memory, it’s not being positioned as a replacement for hard drives but rather as an adjunct technology. Bubble memory crashed and burned as hard drive technology costs dropped while its performance improved.

PRAM’s scalability and its capacity for storing up to four data values in a single bit should prove a double-tap hit to traditional flash memory. And when it achieves economy of scale, it could give DRAM a run for its money, too.

HOW IT WORKS

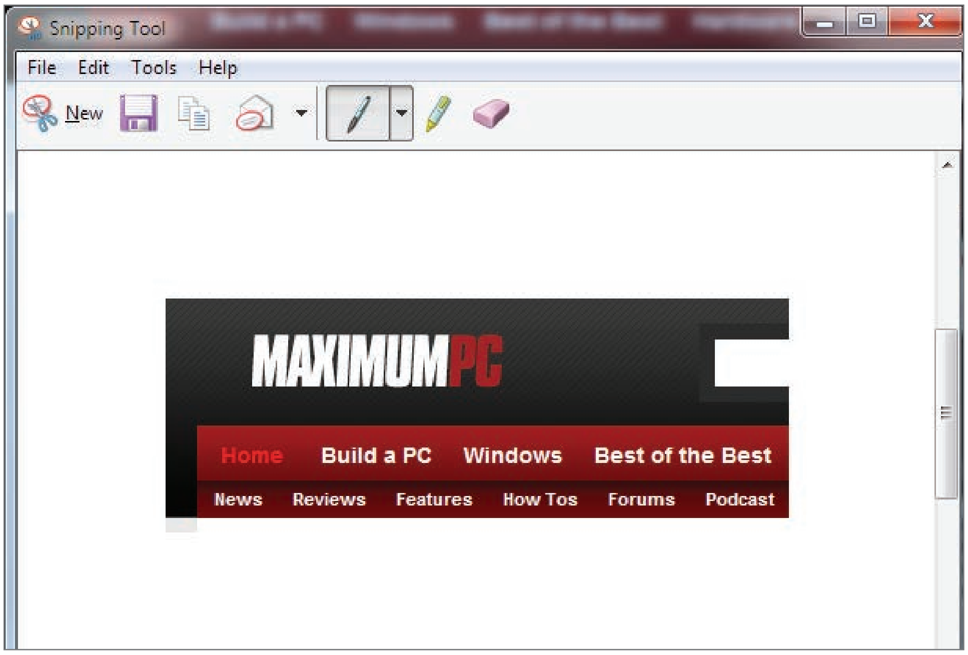
A heating element changes the chalcogenide material in a PRAM cell to a crystalline phase to write to it. The material changes to an amorphous phase when it cools, retaining the data written to it.



HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

WINDOWS TIP OF THE MONTH



USE THE SNIPPING TOOL

Windows Vista and 7 have a special application just for taking screenshots. Open the Start menu, then type "snipping" into the Run box and press Enter. You'll now be able to select a section of your screen to capture, make simple edits to, and save to disk.

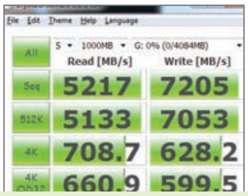
ALEX CASTLE
ONLINE MANAGING EDITOR

THE AMAZING SHIFT KEY

WHEN SOMEONE sees me using an incredibly sophisticated keyboard shortcut and asks how I did it (an occurrence that doesn't happen as often as I'd like, I'll admit), it usually involves the Shift key. Why? Because a lot of people don't understand that Shift is a magical key that turns all your shortcuts inside out. It turns backward to forward, down to up, and close to open. We're through the looking glass here, people. Here are some of my favorite Shifted keyboard shortcuts:

- → Shift + Tab – Select previous
- → Shift + Alt + Tab – Select previous window
- → Shift + F3 – Previous search result
- → Ctrl + Shift + Tab – Previous tab
- → Ctrl + Shift + T – Open last closed tab

MAKE - USE - CREATE



60 Set up a Personal Wiki

62 Get Insanely Fast Storage with a RAMDisk

↘ submit your How To project idea to: comments@maximumpc.com

Set up a Personal Wiki

–Seamus Bellamy

IF YOU'RE LOOKING to build a website where you or other users can create, tinker with, or delete content on the fly from just about any web browser under the sun, you're looking to build a wiki. Wiki-style sites offer a level of inclusion and flexibility unmatched by anything else online today. With a wiki, multiple people can make changes to site content simultaneously, typically with little or no coding expertise. Even if you're not looking to create the next Wikipedia, a wiki can be a great tool for collaboration or personal organization.

Unfortunately, things on the back end of some of the most popular wiki applications, such as Mediawiki, Instiki, and Dokuwiki require that an administrator be conversant in PHP or SQL to get things up and running. That said, not every wiki website requires a truckload of coding knowledge to implement. If you're interested in creating your own wiki to use alone or with a far-flung team of contributors, you can use one of the two methods in this article to get the knowledge-sharing ball rolling in no time at all.

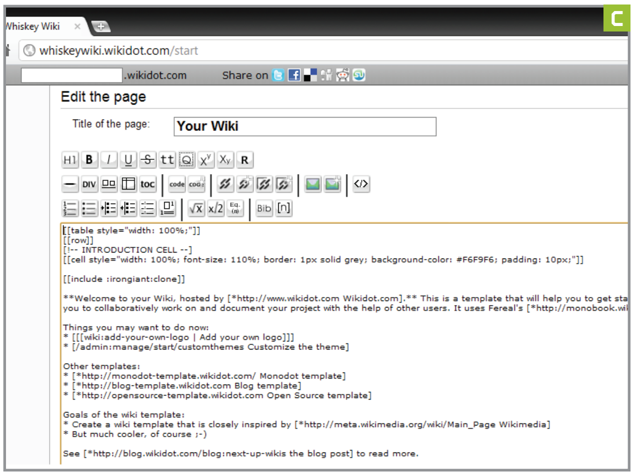
Wiki on a Web Host

FOR ANYONE WHO wants to get their wiki up and running with little or no heavy digital lifting involved, using a wiki-centric web service provider like Wikidot is a great way to go. Offering a wide range of free and paid subscription models that include a very respectable number of customization options, there are few wiki-centric web hosts operating today that can match Wikidot for its flexibility and user-friendly feel.

1 MEET WIKIDOT To get started with Wikidot, navigate to the service's main page (www.wikidot.com), select a pricing option, and choose a name for your wiki's domain. For this exercise, we've opted to go with Wikidot's free subscription plan, but the setup process is similar no matter what plan you decide upon. Once you've chosen a name for your wiki, click the Get It Now button **(image A)**. You'll be asked to create a Wikidot account and provide a few pieces of basic information about yourself. Once this is done, an account confirmation notice will be sent to you via email. Click the enclosed link and log into your new Wikidot account.

2 SET UP YOUR WIKI Upon logging in, you'll be asked to set up your wiki, decide on a title, tagline, web address, and template style **(image B)**. Users are also given the option of choosing an interface language and selecting an access policy—open, closed, or private—for their site.

3 CUSTOMIZE AND POPULATE After reticulating a few splines, your new wiki site will be ready to go. You'll note that Wikidot has populated your wiki with some useful information to give you an idea of what the template should look like once you and your collaborators have uploaded some new content to it **(image C)**. Users are invited to add a customized logo, tinker with their template's theme, and modify the wiki's content using a wide variety of HTML code snippets provided free of charge—a nice perk for individuals with little or no coding experience.



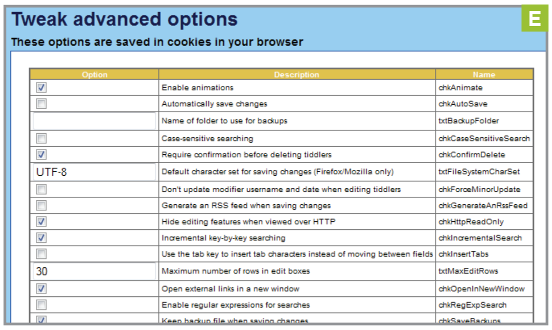
Wiki in Your Dropbox

IF YOU'RE LOOKING to leverage the organizational power of a wiki to keep your personal affairs in order but want to do so without having to rely on a web host, or worse, deal with the frustration and hassle of setting up a database and home server, TiddlyWiki is a fantastic option. A wiki system contained in a single .html file, TiddlyWiki can be accessed through any modern web browser on any platform with or without web access. When paired with a Dropbox account, TiddlyWiki becomes a ubiquitous information powerhouse that you'll be able to access from just about anywhere you go.

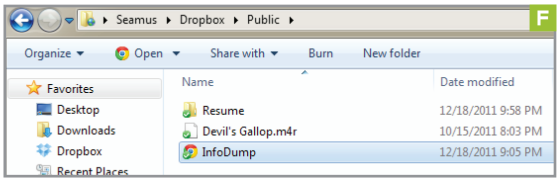
1 DOWNLOAD TIDDLYWIKI In order to set up TiddlyWiki, you're gonna have to download it first. Fortunately, the application can be obtained for free from www.tiddlywiki.com. Download the version designed for Windows Vista and extract it to your desktop. By default, the file will be named "empty." Rename the file to something memorable so that it doesn't get lost in the gazillions of other files floating around your rig.

2 SET UP SHOP Locate the TiddlyWiki .html file and double-click to open it. Doing so should open a TiddlyWiki start page in your default browser. To get you up and running, TiddlyWiki will suggest that you personalize your wiki by changing its name and subheading **(image D)**. Click the hyperlink for each and alter the text in the field provided. Once you're finished, click Done, which you'll find just above the text entry field you've been tinkering with. You'll also want to enter your name using the field provided, so that you can claim credit for any future edits. Now, look to the right-hand side of your browser window and click Save Changes.

3 TWEAK In the top-right corner of your browser window, locate a link labeled Backstage and click it. Doing so gives you access to a number of drop-down menus chock-full of options designed for customizing your TiddlyWiki **(image E)**. Change the settings as you see fit. Extras, such as themes and plugins can be downloaded from TiddlyWiki.com, making it easy to pimp out your wiki right.



4 DROP IN ON DROPBOX If you haven't already signed up for a free Dropbox account and installed the service's client on your rig, stop by www.dropbox.com and follow the instructions provided. Once you're up and running with Dropbox, open your computer's Dropbox folder and drag your TiddlyWiki .html file into it. The file will be uploaded to Dropbox's servers, making it both accessible and editable from any computer or mobile device with a Dropbox client installed on it, tablets and smartphones included. If you opt to place the file in your Dropbox account's Public folder **(image F)**, it becomes possible to share your TiddlyWiki with others, turning your personal wiki into a private members-only website.



Why Use a Wiki?

There's no wrong way to use a wiki. A flexible, multipurpose platform, your new wiki can fulfill many different roles.

ONE-STOP INFORMATION SHOP

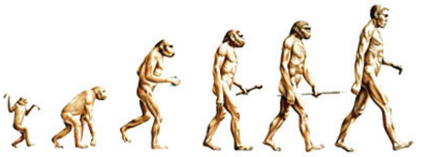
Your wiki can provide you with a space to jot down quick notes, rough project outlines, capture information from other online sources, or even piece together your shopping list. What's more, it can all be accessed from just about anywhere you can get online with a web browser.

COLLABORATE FROM ANYWHERE

Wiki users can instantly collaborate on projects with others no matter where they are in the world without having to shuttle content back and forth via email or rely on services such as Google Docs.

TRACK YOUR PROGRESS

Wikis are designed to track all revisions made to their contents, making it easy to keep track of how your ideas have formed, from rough draft to final product.



Get Insanely Fast Storage with a RAMDisk –Alex Castle

WHEN YOU GET DOWN to it, memory is memory. Your hard disks, SSDs, RAM, and even CPU cache are all structurally and functionally very different, but they still do the same thing—store ones and zeroes. Each type of memory is well suited for its particular job, but there are times when you might want to use them a little differently.

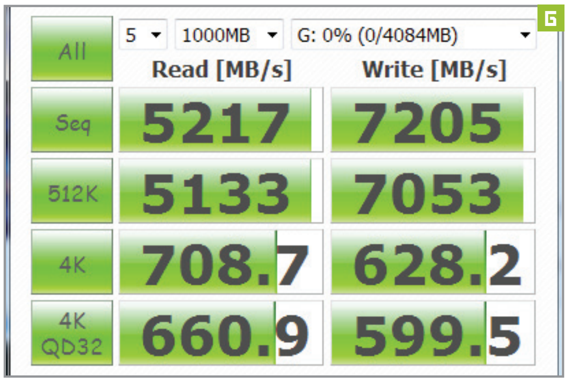
That's the case with a page file, which uses your slower secondary memory to extend your RAM. However, these days, RAM has gotten so cheap and so plentiful that a page file is rarely used. Instead, you should consider the reverse: You can use extra space in your RAM to extend your computer's filesystem using RAMDisk software.

1 SHOULD YOU USE A RAMDISK?

There are big advantages to using RAM as a hard disk, and none are bigger than the speed boost you'll get by switching to RAM. RAM is fast memory, and in our benchmarks a RAMDisk performed reads and writes at nearly 10 times the speed of even a top-quality SSD **(image G)**. That's fast.

» The disadvantages of a RAMDisk are capacity and volatility: Capacity, because RAM just isn't very big, normally. That's what has kept us from using RAMDisk in the past, but now that 32GB of RAM is a very affordable option for your PC, you should have enough to spare for a modest-size RAMDisk. The volatility issue is that RAM gets cleared out every time it powers down. Most RAMDisk software has the option to write to an image file on system shutdown or on a timer, but you'll always run the risk of losing recently saved data in a power outage.

» So, generally speaking, a RAMDisk is a great option for someone who needs small amounts of very fast storage on a temporary basis. Video editing and encoding are great examples of this, as is editing large batches of photos.



2 INSTALL A RAMDISK

There are multiple RAMDisk software packages available, but we recommend that you start out with DataRAM RAMDisk (bit.ly/ZeEZ3). It's not the most fully featured product available, but it's got the big advantage of being free for disks up to 4GB. It's also easy to install and use, so it makes a great option for trying out a RAMDisk, and deciding if it's something you'd like to use.

» Another example of RAMDisk software is SuperSpeed RamDisk (www.superspeed.com), which has a better feature set, but the free version is only a trial, and an upgrade costs $50—more than the $15 it costs to upgrade DataRAM RAMDisk.

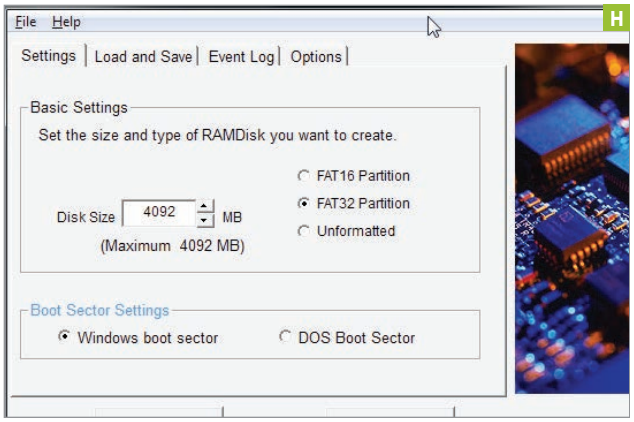
» Download DataRAM RAMDisk and run the .msi file to install the software.

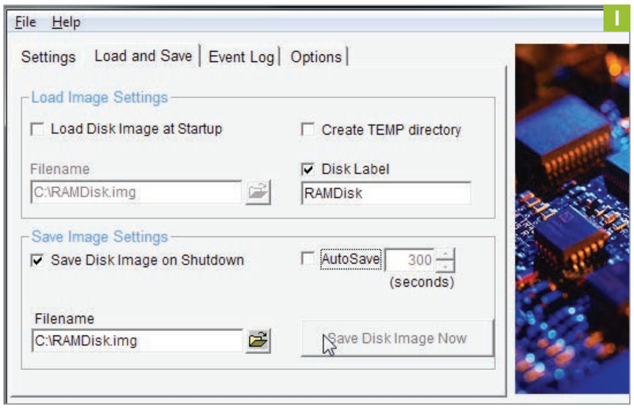
3 CONFIGURE YOUR RAMDISK

After you've installed the software, open the Start menu, navigate to the DataRAM RAMDisk folder, and launch the Configuration Utility. The configuration program will open, and you'll be able to choose what you want your RAMDisk to look like. In the first tab you'll be able to choose the size and filesystem for your RAMDisk to use **(image H)**. Select as much memory as you want to use (remembering that the free version only allows up to 4GB of space) and pick the FAT32 filesystem.

» The second tab lets you configure the RAMDisk's image file, which allows it to persist even if you shut down your PC **(image I)**. We strongly recommend that you tick the checkbox for the second section, so that your RAMDisk will save to a file on system shutdown. Next time you use the RAMDisk you can select the first checkbox and load that file.

» Once you've done all that, click the button at the bottom of the window to start the RAMDisk. Even if you close the configuration utility, your system will still see the RAMDisk. Load a storage benchmark, and marvel at the insane speeds.





BUILD IT

GORDON MAH UNG **DEPUTY EDITOR**

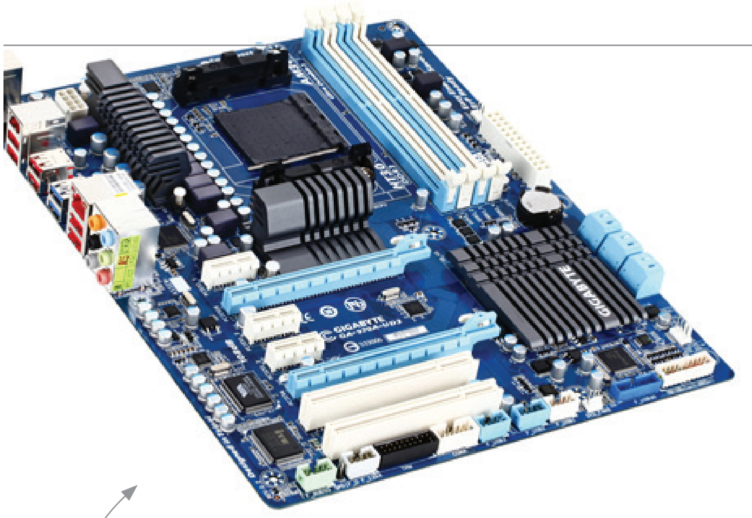
Here's What $830 Gets You

Putting together an all-purpose rig under a strict budget is the best way to keep a PC builder on his or her toes

LENGTH OF TIME: **2.5 HOURS** | LEVEL OF DIFFICULTY: **INTERMEDIATE**

THE MISSION Building expensive, over-the-top machines is easy. It's when you dip below the $1,000 mark that it gets difficult. This month, I undertook the challenge of building the best all-around PC I could for less than $850. To me, that meant a machine good at multithreaded tasks as well as gaming. We've said it before, and we'll stick to our guns: Intel's Core i5-2500K is the sweet spot for price/performance. Unfortunately, that price is too high for this configuration. That left me pondering whether to do yet another Core i3 box or another AMD box.

Readers have been ragging on us about what fantastic deals Phenom II procs currently are. I looked high and low and, surprisingly, I did find some e-tailers selling Phenom IIs way below the list price. For just $139, you can net a 3.5GHz Phenom II X4 970. That gives you four cores, a much larger cache, and a fully unlocked part for not much more than the Athlon II X4 has been going for. The Phenom II X4 isn't always a clear-cut winner against its Intel counterpart, the 3.3GHz Core i3-2120, but it does hold its own in multithreading tasks and game-related chores, which are all about the GPU.



PICKING THE OTHER PARTS

I INITIALLY PICKED Nvidia's GeForce 560 Ti card for this build, but later decided to swing ATI because our motherboard, a Gigabyte GA-970A-UD3, only offers CrossFireX support. To get SLI on an AMD board, you need to pony up for a 990FX chipset, which would have broken my budget. The best deal seems to be the Radeon HD 6950 card. The 6950 is a cut-down Radeon HD 6970 made to rain on the GeForce 560 Ti's parade. Gigabyte's GV-R695UD was about the cheapest I could find at the time, and it features enhanced cooling over a stock card.

When it came to the other components, I had one thing working for me and another against me. Working for me was system RAM. RAM is so cheap that building a rig with even 32GB is doable (provided you have eight DIMM slots). However, 4GB is about all you really need in a budget box—and all I could afford. Yes, 8GB would have been nice, but I had to save pennies for something really out of control: the hard drive.

Here's how dire things are right now: In August 2011, we built a $667 PC that had a 1TB WD Caviar Blue drive for $60. This year, I was happy to get a bare 500GB Western Digital Blue drive for $99. In fact, the drive I snagged for this build had already risen 30 percent in price by the time I finished building my rig. The same hard drive six months ago sold for $34!

I'm still sticking to the $99 price, as that was the price when I originally configured the machine, but by the time you read this, the hard drive could be $500, and we'll be living in a dystopian world where people are scrounging e-waste dumps looking for 32MB USB keys discarded in 2003. I'll pull up in my busted-up $830 PC and some dirty, toothless PC mechanic will marvel at the "last of the 500GB Interceptors! A piece of history!"

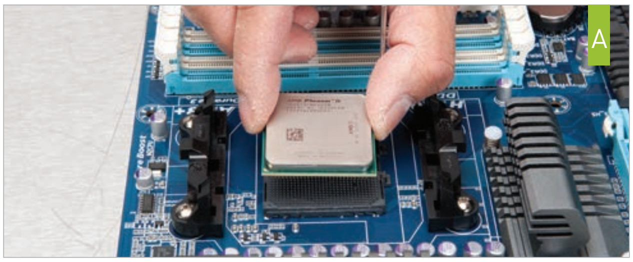
INGREDIENTS

PART/URL	PRICE
Case Bitfenix Outlaw www.bitfenix.com	$47
PSU Rosewill RG700-S12 www.rosewill.com	$50
Mobo Gigabyte GA-970A-UD3 www.gigabyte.com	$99
CPU AMD 3.5GHz Phenom II X4 970 Black Edition www.amd.com	$139
Cooler Cooler Master Hyper 212 Plus www.coolermaster.com	$21
GPU Gigabyte GV-R695UD www.gigabyte.com	$239
RAM 4GB Patriot DDR3/1333 www.patriot.com	$19
Optical Drive Samsung SH-2222 www.samsung.com	$18
Hard Drive Western Digital Caviar Blue 500GB www.westerndigital.com	$99
OS Microsoft 64-bit Windows 7 Home Premium (OEM) www.microsoft.com	$99
TOTAL	**$830**

ASSEMBLING THE HARDWARE

1 INSTALL THE BRAINS

TO KEEP THINGS easy, I installed the Phenom II X4 970 with the board out of the case. First, drain any built-up static electricity by touching a large metal object. Unlock the AM3+ socket by lifting up the arm. Match the gold triangle in the CPU's corner with the white corner marker on the motherboard **(image A)**. Gently lower the chip into the socket until it rests flush with the socket. Now lock the arm in place, and you've just installed your CPU **(image B)**.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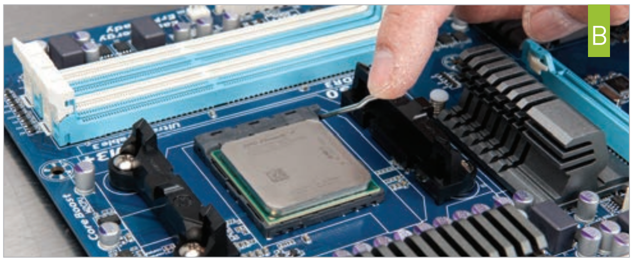
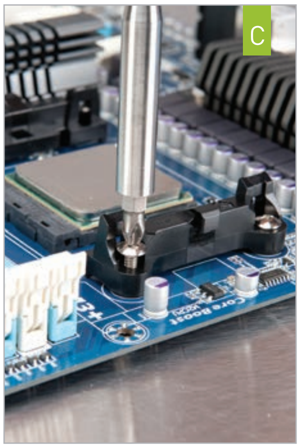

B

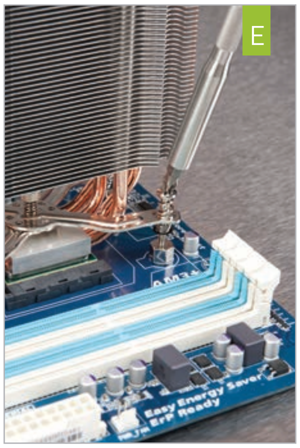
2 INSTALL THE COOLER AND RAM

I WENT WITH the amazingly cheap ($20!) Cooler Master Hyper 212 Plus. It offers far more performance than the stock fan. To install it, first remove the stock mounting bracket from the motherboard by using a Phillips-head screwdriver to remove both of the plastic brackets on top (image C). The metallic backplate on the back should now pop off. Reassemble the bracket and place this in your motherboard box in case you need it in the future. Now place a small dab of thermal paste on the CPU heat spreader. You can use a plastic bag as a makeshift glove to spread the paste on the heat spreader's surface.

The Hyper 212 Plus comes with a backplate, which you will have to hold in place while you install the bracket. With the bracket in place, install four of the nut-and-screw assemblies to hold the bracket in place. Now use the included tool to lightly torque the screws in place (image D). Don't over tighten, as it could chew into the motherboard. Remove the fan from the cooler, and spread the X-shaped bracket through the base of the cooler. Now, using a screwdriver, attach the x-bracket to the four exposed nuts with the four spring screws (image E). Once the cooler is firmly attached, snap the fan back in place and hook up the fan to a fan header. For my configuration, I set the fan to blow air through the cooler where it would be exhausted through the case's rear fan.

While the board is out, you might as well install the RAM by matching up the notches in the RAM with the notches in the slots. On this board, I installed the pair of 2GB modules in the two blue slots (image F). If you're not using this board, you should consult your manual to see how to install the RAM for dual-channel mode.





3 PREP THE CASE

INSTALL the optical drive in the bay of your choice, which will be the top bay for most people, since the system will likely sit on the floor. At this point, you should also install the hard drive in one of the bays that will clear the GPU, as the hard drive will jut out quite a bit in this BitFenix case (image G). You should now install the PSU, as well. I chose to face the fan intake toward the bottom of the case—that way, air is sucked in through the bottom and vented out the rear.

4 MOUNT THE MOTHERBOARD

THE BITFENIX case is a bit unusual in that it features an inverted design that flips the guts of the case. Remember to knock out the rear metallic I/O panel that's in the case before you mount your board. When you mount your board, make sure you use as many screws as you have mounts in the case. If you have nine mounting points, you should use nine screws or you will need to remove the board and start all over again **(image H)**. You should know that the BitFenix case is a bit shallow, and the Hyper 212 Plus is a little tight in the case. The side panel will fit, but it will be right up against the cooler.

5 MOUNT THE GPU

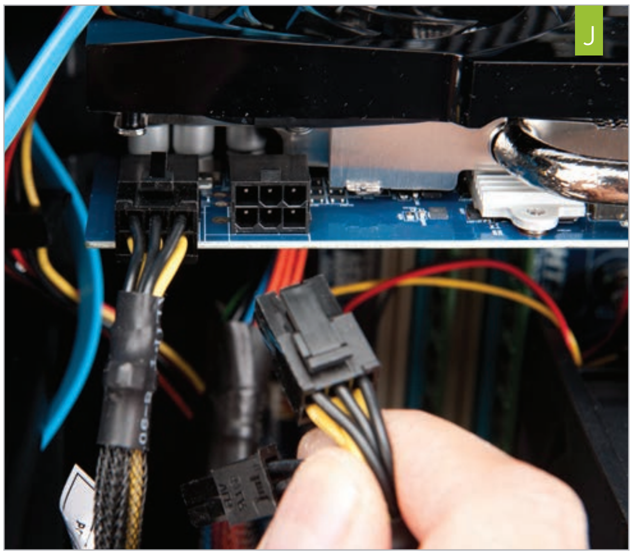
THE GIGABYTE version of the Radeon HD 6950 features three fans to keep it cool—and in my case, they're flipped over so the warm air is directly vented out the top. Remember, since the case is inverted, you'll be installing it in the x16 PCIe slot that is the lowest in the board **(image I)**.

H

I

6 CONNECT THE UMBILICAL CABLES

CONNECT THE main power connector, the ATX12V, and pipe power to the GPU, HDD, and ODD. You should also take the time to connect the power switch, LED, and reset switch, and plug in the USB and front audio panel headphone jack **(image J)**.


J

1. For a mere $99, this Gigabyte GA-970A-UD3 AM3+ board gives you CrossFire support and modern amenities.

2. The Radeon HD 6950 is just a step down from the Radeon HD 6970, and pretty durn cheap, too.

3. This old AMD Phenom II X4 970 still has a few tricks left in it, especially if you overclock it a teeny bit with the aid of the Cooler Master Hyper 212 Plus.

4. We feel lucky to have scored our Western Digital 500GB Caviar Blue for $99. Will we laugh when we look back at the great hard drive shortage of '11, or cry?

BUDGET BURNER OR JUST BURNT?

OUR BUDGET burner doesn't set any benchmark records. Nor would we expect it to at a mere $830. Even up against our old zero-point system with its 2.6GHz Core i7-920 overclocked to 3.5GHz, the $830 rig didn't win any battles (mind you, our zero-point cost north of $2,500 when originally constructed).

Where the $830's talents come into play is against far more modest machines. For example, when put up against the $667 rig we built in August 2011, the extra cash helps out. That 3.1GHz Core i3-2100 box takes a back seat in our multithreaded tests, and the Radeon HD 6950 eats the $667 Radeon HD 6790's lunch, as well as dinner.

In the interest of full disclosure, I did decide to give the $830 a little extra edge by overclocking the Phenom II X4 970 to 4.1GHz. Since I paid $20 for the Cooler Master Hyper 212 Plus, I figured I'd make it work for a living. But what about last month's $1,500 AMD FX-8150 Bulldozer box? The $830 box's four cores couldn't hang with the Bulldozer's eight cores, but in gaming benchmarks, the Radeon HD 6950 isn't that much slower than the Radeon HD 6970 in the pricier box. In STALKER, I'm only giving up 7 percent, and Far Cry 2 saw a mere 5 percent delta between the two rigs. That ain't bad when you're looking at $830 vs. $1,500. To be fair, that Bulldozer rig also didn't have Microsoft's new hotfix that specifically addresses Windows 7's scheduler issues with the Bulldozer chip, so there's a good chance that last month's machine is even faster today.

Still, I'm not unhappy with the performance of this machine, especially the frame rates I'm seeing. Not everything is perfect, though. It's hard to believe that I had to fall back to a 500GB HDD to make budget, and it would have been nice to run 8GB of RAM instead of the 4GB of DDR3/1333. I also must note that there have been negative comments regarding the reliability of budget Rosewill PSUs, but I'll take the risk because they're low-cost and, more importantly, have a U.S.-based website where you can actually use the two-year warranty. You can't say that for a lot of budget PSUs, where the warranty is in name only.

BENCHMARKS

	ZERO POINT	
Vegas Pro (sec)	3,049	4,980 (-39%)
Lightroom 2.6 (sec)	356	453 (-21%)
ProShow 4 (sec)	1,112	1,662 (-33%)
MainConcept 1.6 (sec)	2,113	2,848 (-26%)
STALKER: CoP (fps)	42.0	30.7 (-27%)
Far Cry 2 (fps)	114.4	94.2 (-18%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our current desktop test bed consists of a quad-core 2.66GHz Core i7-920 overclocked to 3.5GHz, 6GB of Corsair DDR3/1333 overclocked to 1750MHz, on a Gigabyte X58 motherboard. We are running an ATI Radeon HD 5970 graphics card, a 160GB Intel X25-M SSD, and 64-bit Windows 7 Ultimate.

REVIEWS

TESTED. REVIEWED. VERDICTIZED.

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80 Cooler Master Cosmos II Case

82 Silverstone Temjin TJ08-E microATX Chassis

83 D-link DIR-645 Wireless Router

84 3D Projector Roundup: Acer H9500BD, Epson Home Theater 3010, and Optoma HD33

86 Asus Eee Pad Transformer Prime TF201 Android Tablet

88 Samsung SyncMaster T27A950 3D Display

89 Motorola Droid Razr Android Phone

90 Turtle Beach Ear Force Z6A PC Gaming Headset

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92 Lab Notes

IBUYPOWER EREBUS PAGE 74

iBuypower Erebus

Boutique look and feel without the boutique price

The Erebus is built within a massive tower akin to Corsair's 800D and is fully outfitted for water cooling.

WE USED TO SAY that iBuypower should really be named iStealpower, because we've never understood how the company can sell such well-configured systems for such low prices. With its new Erebus line, iBuypower is maintaining its low-price strategy while stepping upmarket to compete with boutique vendors. Is the Erebus priced low enough to purchase on a whim? No, but considering what iBuypower packs into the rig, it's a pretty good deal.

First up: The Erebus uses a custom NZXT-built case that takes its cues from Corsair's groundbreaking 800D. Not to be upstaged, the Erebus case is almost an inch or two bigger in all dimensions, and it's designed to be jam-packed with rads. The Erebus we reviewed had a massive quad radiator plus two dual radiators—with room for more. The Erebus case is designed for water cooling, and that quad radiator is integrated into the top of the unit with a plug you can use to top off its reservoir. It's an impressive case, with the only major ding against it being its pass-through USB 3.0 cables—that's *so* 2011. You'll be hard pressed to find a new motherboard that doesn't use internal USB 3.0 headers.

iBuypower stuffs a liquid-cooled 3.2GHz Core i7-3930K inside the Erebus, along with an Asus Rampage IV Extreme board, 32GB of DDR3/1600, a 1,200-watt Corsair PSU, a 120GB Force GT SSD, a 2TB hard drive, and a pair of liquid-cooled EVGA GTX 580 cards. The magic here is the 3.2GHz Core i7-3930K. It's the little brother of the Core i7-3960X, with the main difference being the loss of 100MHz off its top speed, and a cache that's cut down from 15MB in the X to 12MB in the K. Both procs seem equally adept at overclocking, though, and iBuypower takes the K to a very stable 4.7GHz. We ran Prime95 on the box for several hours with no issues. We also ran the GPUs overnight with no instability.

So how does the Erebus perform? Quite well. It managed to set a record in ProShow Producer 4.0, just edging out the Maingear Shift we reviewed in our February 2012 issue. In terms of its application performance, it's pretty much dead even with the Sandy Bridge-E machines we've reviewed from Falcon Northwest, Digital Storm, and Maingear. That's good company to be in.

Where the Erebus falls behind—by just a bit—is gaming performance. It's not terrible—two liquid-cooled GeForce GTX 580s can't be terrible—but the Falcon Northwest Mach V used overclocked 580s with 3GB frame buffers. The Digital Storm HailStorm had tri-SLI'd 580s. And Maingear went plumb crazy with essentially quad-SLI'd 580 cards. In most games, you won't see a difference; in fact, iBuypower's rig runs close to the others in Far Cry 2 and STALKER even at 2560x1600. But in the synthetic 3DMark11 and DX11 Unigine Heaven 2.5 tests, the iBuypower lags, coming in last place with 34fps in Heaven. Maingear scores best, with 69fps; tri-SLI, FYI, will give you 50.8fps, and the 3GB GTX 580 cards hit 42fps.

The real story here is iBuypower's pricing: The Falcon weighs in at $6,993, the Digital Storm at $7,640, and the Maingear is just nuts at $8,876. Priced at $5,000, there's no denying that the Erebus is a steal. It doesn't sport a fancy paint job, but it's no slouch in performance and looks pretty damn nice, too. –GORDON MAH UNG

VERDICT 9 KICK ASS!

iBuypower Erebus

BUY Get that boutique look and feel without the nosebleed price.

SELL USB 3.0 pass-through cables? For real?

$5,000, www.ibuypower.com

BENCHMARKS

	ZERO POINT	
Vegas Pro (sec)	1,710	1,730
Lightroom 2.6 (sec)	234	230
ProShow 4 (sec)	728	739
MainConcept (sec)	1,265	1,295
STALKER: CoP (fps)	101.0	124.4 (+140%)
Far Cry 2 (fps)	200.0	220.9

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our current desktop test bed consists of a quad-core 2.66GHz Core i7-920 overclocked to 3.5GHz, 6GB of Corsair DDR3/1333 overclocked to 1,750MHz, on a Gigabyte X58 motherboard. We are running an ATI Radeon HD 5970 graphics card, a 160GB Intel X25-M SSD, and the 64-bit version of Windows 7 Ultimate.

SPECIFICATIONS

Processor	Intel 3.2GHz Core i7-3930K OC'd to 4.7GHz
Mobo	Asus Rampage IV Extreme using Intel X79 chipset
RAM	32GB DDR3/1866
Videocard	Two EVGA GeForce GTX 580 Hydro Copper 2 in SLI
Soundcard	Onboard
Storage	120GB Corsair Force GT, 2TB Hitachi 7,200rpm HDD
Optical	LG Blu-ray combo drive
Case/PSU	NZXT Erebus / Corsair 1,200 watt

The Eurocom Neptune 3D's industrial design won't turn any heads, but its black, brushed-metal finish has a certain minimalistic charm.

Eurocom Neptune 3D

Setting a new standard for standard

WE REVIEWED Eurocom's top-of-the-line mobile workstation, the Panther 2.0, in our June 2011 issue. That high-end behemoth weighed more than 15 pounds and cost upward of $5,000, but it sported a desktop Core i7-980X CPU and a pair of Radeon HD 6970s in CrossFire. This time around we're taking a look at the company's lighter-weight mobile workstation, the Neptune 3D.

While also billed as a high-end desktop-replacement, the Neptune 3D is far more modest than its beefy big brother. It's based on a mobile Sandy Bridge CPU (Intel's Core i7-2760QM) and a single mobile GPU (Nvidia's GeForce GTX 580M). The Neptune 3D weighs less than nine pounds, but its defining feature is its 17.3-inch, 120Hz, 3D display.

Eurocom bundles one pair of Nvidia's 3D Vision active-shutter LCD glasses with the machine, and the emitter is built into the chassis. The 1920x1080 LED-backlit panel is strikingly bright, no doubt to compensate for the darkening the glasses cause. After we turned it down a bit to evaluate the screen's quality, we saw that it produced crisp text and still images, as well as impressively dark blacks. The display was equally impressive in motion, with no visible blurring or ghosting. The matte finish did a great job of reducing ambient glare. If you dig 3D, you'll enjoy the 3D experience the Neptune delivers; if you're not sold on 3D, nothing about this notebook will change your mind.

Storage comes in the form of a 250GB Intel SSD, supplemented by a 750GB mechanical hard drive. The machine is also outfitted with an optical drive that can burn Blu-ray media at 6x speed and DVDs at 8x. The chiclet-style keys are comfortable and responsive. Lap weight and a two-hour battery life are well within standard range for high-end gaming notebooks.

Aside from the 3D feature, the Neptune 3D's all-around performance is the epitome of standard. It trounced our aging zero-point machine, but that's exactly what we expect from a system running Sandy Bridge hardware. As a gaming laptop, the Neptune 3D is equally sufficient. The GeForce GTX 580 handled all but the most demanding games with relative ease, and the system delivered benchmark numbers on par with a similarly clocked Sandy Bridge desktop machine.

The main issue here is cost. With a price tag just shy of $3,500, we expect a bit more bang for our buck. The 3D video is nice, but it's not enough to justify the Neptune 3D's gaudy price tag. Eurocom should have overclocked the CPU for even better all-around performance, or dropped a second GPU under the hood for faster gaming.

Still, if you're looking for a well-constructed desktop replacement with a sharp display, 3D capability, and strong all-around performance, the Eurocom Neptune 3D won't disappoint. But if you're looking to raise the bar on high-performance mobile gaming, look elsewhere; the Neptune 3D is remarkably unremarkable. –DAN SCHARFF

VERDICT 7

Eurocom Neptune 3D

➕ **JUPITER** Solid all-around performance; bright and vibrant display; 3D capable.

➖ **URANUS** Poor price-to-performance ratio; heavy with power brick.

$3,470, www.eurocom.com

BENCHMARKS

	ZERO-POINT	
Premiere Pro CS3 (sec)	899	491.0
Photoshop CS3 (sec)	131	78.0
ProShow Producer (sec)	876	559.0
MainConcept (sec)	1,782	1,097.0
Far Cry 2 (fps)	48.5	86.1
Call of Duty 4 (fps)	62.2	173.9 (+179.6%)
Battery life (min)	96	129.0

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point notebook is an Asus G73Jw-A1 with a 1.73GHz Intel Core i7-740QM, 8GB DDR3/1066, two 500GB Seagate 7,200rpm hard drives, a GeForce GTX 460M, and Windows 7 Home Premium 64-bit. Far Cry 2 tested at 1680x1050 with 4x AA; Call of Duty tested at 1680x1050 with 4x AA and 4x anisotropic filtering.

SPECIFICATIONS

CPU	2.4GHz Intel Core i7-2760QM
RAM	8GB DDR3/1600
Chipset	HM67
Drives	250GB Intel 510 SSD, 750GB 7,200rpm SATA hard drive
Optical	Blu-ray/DVD combo burner
GPU	Nvidia GeForce GTX 580M with 2GB GDDR5
Connectivity	HDMI out, DVI out, 2x USB 3.0, 2x USB 2.0, 1x FireWire, 1x eSATA/USB, CATV, Ethernet, Bluetooth+, 802.11 a/g/n, headphone, mic, line-out, rear speakers, media card reader
Lap/Carry	8 lbs, 11.3 oz / 11 lbs, 3.8 oz

You would think that in exchange for taking up thee PCIe slots, this card would offer superior performance, but that's not the case.

Asus GeForce GTX 570 DirectCU II

Asus pairs its three-slot cooling tech with a GTX 570

ASUS HAS GOTTEN a lot of mileage out of its beefy DirectCU II GPU-cooling technology. It has brought some serious overclocking chops to the GeForce GTX 580 in the form of Asus's Matrix-branded edition, for example. The DirectCU II versions of the GeForce GTX 560 Ti and the Radeon HD 6870 also sport serious overclocks, and those cards perform well in their respective classes. What's even better is that the company doesn't charge much of a price premium for its best cooling tech on cards below the Matrix GTX 580.

We're scratching our heads, however, over Asus's decision to offer this GTX 570 card in a three-slot configuration similar to its Matrix GTX 580, but running at Nvidia's reference clock speeds. The beefy cooler delivers plenty of DIY overclocking potential, but you must assume all the risk. Since we review cards based on out-of-the-box performance, we had to benchmark this one with its 742MHz core clock and 3,800MHz (effective) memory clock.

One good thing the new cooler does provide is fewer decibels. This card isn't whisper-quiet under load, but it generates much less noise than many of the cards in its class—particularly the Radeon HD 6970, which can get fairly loud under heavy loads.

But performance matters, too, and that's where the GTX 570 DirectCU II fails to justify its three-slot profile. With benchmark results across the board coming within a whisker of Asus's first reference-design GTX 570 card, we need no further proof that the only difference between the two is the former's oversize fan and heatsink.

As you can see in our benchmark chart, EVGA's seriously overclocked GeForce GTX 560 Ti 448 outpaces Asus's GeForce GTX 570 DirectCU II in most titles. XFX's Radeon HD 6970 also comes close to beating it while consuming less power (although, as we mentioned earlier, the 6970 is a bit louder under load).

And then there's the fact that this card consumes three freakin' slots! Without a factory overclock, there's just no good reason for this card to take up so much real estate. Yes, it produces less noise than a card equipped with a reference-design cooler, but it's only marginally quieter than the overclocked EVGA GTX 560 Ti 448. What's the point? **–Loyd Case**

BENCHMARKS

	Asus GTX 570 DirectCU II	EVGA GTX 560 Ti 448	Asus GTX 570	XFX Radeon HD 6970
Price	$340	$290	$350	$330
3DMark 2011 Perf	6,063	**6,153**	5,987	5,750
3DMark Vantage Perf	**24,493**	24,434	24,432	24,453
Unigine Heaven 2.5 (fps)	29	**32**	29	24
Shogun 2 / 1080p (fps)	44	45	44	**50**
Far Cry 2 / Long (fps)	109	**111**	108	106
DiRT3 (fps)	**67**	65	65	63
HAWX 2 DX11 (fps)	154	**155**	152	103
STALKER: CoP DX11 (fps)	38	37	37	**39**
Just Cause 2 (fps)	**52**	51	**52**	45
Batman: Arkham City (fps)	**61**	**61**	60	58
Metro 2033 (fps)	22	22	22	**23**
Core / Memory Clocks (effective)	742 / 3800	797 / 3900	742 / 3800	880 / 5500
System Power @ idle (W)	127	133	130	**126**
System Power @ full throttle (W)	310	361	304	**296**

Best scores are bolded. Our test bed is a 3.33GHz Core i7 3960X Extreme Edition in an Asus P979X Deluxe motherboard with 16GB of Corsair DDR3/1600 and an AX1200 Corsair PSU. The OS is 64-bit Windows Ultimate. All games are run at 1920x1200 with 4x AA unless otherwise noted.

VERDICT 6

Asus GeForce GTX 570 DirectCU II

+ THE JOKER Quiet; solid performance; reasonable price for its class.

– THE PENGUIN Costs more than a GTX 560 Ti 448; consumes three PCIe slots.

$340, www.asus.com

When you're not using the TouchSmart keyboard, you can slide it beneath the monitor to recover space on your desk.

Touching Desktops

Toshiba joins HP in the touchscreen all-in-one market

HP has been building all-in-one PCs with touchscreen displays for years. Toshiba is well known for building multimedia laptops, but has never had much of a presence in the desktop market. Toshiba sent us a Core i5 machine, and HP sent a Core i7 model, so it wouldn't be fair to pit them head-to-head in terms of performance. But we can certainly compare design, usability, peripherals, and price/performance ratios. –MICHAEL BROWN

HP TOUCHSMART 520-1070

HP once built its TouchSmart line using notebook components because they required much less active cooling. Limiting the number of fans inside the machine made it quieter. This TouchSmart not only uses a desktop CPU—Intel's low-power Core i7-2600S, running at a stock 2.8GHz—but HP has also packed a discrete GPU inside this TouchSmart's chassis. AMD's Radeon HD 6550A might not be a barn-burner of a videocard, but it is vastly superior to the GPU core integrated into the Core i7. The Radon HD 6550A is DirectX compatible, but that doesn't mean it will deliver a satisfying performance with highly demanding games. Playing Metro 2033 at 18 frames per second—in DirectX 10 mode—is not very satisfying. But no one will buy this type of a machine for gaming.

All-in-one computers provide extremely limited upgrade options, so we were happy to see that HP planted plenty of memory inside this one: 8GB of DDR3/1,336MHz running in dual-channel mode. While we like having a 2TB hard drive at our disposal, the one HP selected spins at just 5,400rpm. HP makes up for that by including a combo slot-feed Blu-ray player/DVD burner. The rest of the package is pretty much what we expect to find in a machine of this type. There's an integrated 1MP webcam (unlike some earlier TouchSmart models, this one cannot be tilted independently of the rest of the chassis); an integrated HDTV tuner; Bluetooth, Wi-Fi (802.11n), and gigabit LAN networking; a 6-in-1 media card reader; and six USB ports (including two USB 3.0 ports on the left side).

HP has long provided an HDMI input that you can use to connect a videogame console or a set-top box to the computer's display, but it moved the input-select button into a group of four other buttons—including the disc-eject button—on the right side of the display. We invariably pushed the wrong button unless we were looking right at the correct one. We like the rest of the new chassis design. It easily swivels left and right, and it tilts very far back, which makes the touchscreen easy to use while standing. The entire chassis is much thinner than earlier models, and the built-in handle at the top makes the computer easier to move. This TouchSmart produces more fan noise than earlier models we've evaluated, but we'll happily trade a little noise for faster performance.

The 23-inch LED-backlit display is bright and vibrant. We wouldn't rely on it for professional photo or video editing, but it's a solid choice for noncritical apps and for watching TV and movies. The speakers integrated into the front of the display are better than average, and there's a subwoofer output if you want to beef them up (and a line-out jack if you want to replace them altogether).

HP built its own touchscreen user interface because earlier versions of Windows weren't well suited to touch gestures. Windows 7 is much better, but HP has once again come up with a significant improvement: a UI it has dubbed Magic Canvas. Magic Canvas consists of a very large desktop that scrolls left and right. A rotating carousel of square icons at the bottom of the screen, above the Windows 7 taskbar, can launch touch-optimized programs, including a web browser. You can also add your own icons to the carousel. If the window you need is not currently displayed on the screen, a click on its taskbar icon will instantly bring it front and center no matter where it is on the Magic Canvas.

HP was offering a $300 instant rebate on this machine at press time, taking its online price down to just $1,200. That's an exceptional price for a computer this powerful.

VERDICT 9

HP TouchSmart 520-1070

$1,200 street, www.hp.com

We find the price/performance ratio of Toshiba's DX735-D3201 all-in-one to be lacking.

TOSHIBA DX735-D3201

Toshiba offers three SKUs in the DX735 line, two with Core i5 CPUs and one with a Core i7. All three models use mobile CPUs, and all three rely on integrated graphics. Whereas HP's TouchSmart 520-1070 is somewhat capable of playing games, Toshiba's DX735 series is not at all capable. If you really want to play games on this machine, we suggest plugging an Xbox 360 into its HDMI input.

The specific model Toshiba sent is outfitted with Intel's 2.4GHz Core i5-2430M. The lower-power and mobile CPU requires much less cooling, and the DX735 was much quieter than HP's machine. Toshiba provides a smaller-capacity hard drive than HP—just 1TB—but at least it's a 7,200rpm model. The DX735 also provides half as much memory as the TouchSmart: 4GB of DDR3/1,333MHz memory running in dual-channel mode. And where HP spoils us with a Blu-ray player, Toshiba meagerly provides a simple DVD burner. And to add insult to injury, it's a tray model. The rest of the spec chart is what we'd expect to find in an all-in-one. There's a 1.3MP webcam integrated into the bezel; six USB ports (two of which are USB 3.0); a memory card reader; Bluetooth, Wi-Fi (802.11b/g/n), and gigabit networking; and an HDMI input (don't buy an all-in-one that lacks this feature).

Toshiba offers several innovative features, including one USB port that can charge an attached device even when the computer is sleeping, hibernating, or completely shut down. You can also plug an audio device into the machine and use its onboard speakers under the same circumstances. Onkyo manufactures the speakers, and there's both Dolby Advanced Audio and Waves MaxxAudio 3 to augment the computer's onboard sound, but we're as unimpressed with Toshiba's audio effort as we are with HP's Beats collaboration. These systems are fine for watching the news or a cooking show, but you'll need discrete powered speakers to get high-quality sound from an all-in-one.

The wireless mouse and keyboard feel flimsy and cheap. And while every prebuilt PC comes with a collection of bloatware, Toshiba's offering is especially galling: Best Buy's PC App, which is set by default to launch every time you start the computer. This is little more than a real-time advertisement and an Internet link to Best Buy's Geek Squad tech-support service. Toshiba's Toshiba Board—a bulletin-board style user interface—reminds us of HP's first-generation TouchSmart interface, but it's not as well optimized for a touchscreen; in fact, it's actually a transplant from Toshiba's non-touch notebook line. The 23-inch LED-backlit screen, on the other hand, is at least as good as HP's—both visually and as a touchscreen. The DX735 is mounted on a TV-style stand with limited tilt. As with the HP, you must move the entire computer to swivel the display right or left.

The DX735-D3201 was selling online for $900 at press time, which seems a little high for an all-in-one with a Core i5 processor, integrated graphics, just 4GB of RAM, and no Blu-ray player.

VERDICT 6

Toshiba DX735-D3201

$900 street, www.toshiba.com

SPECIFICATIONS

	HP TouchSmart 520-1070	Toshiba DX735-D3201
Price (street)	$1,200	$900
CPU	2.8GHz Core i7-2600S	2.4GHz Core i5-2430M
GPU	AMD Radeon HD 6550A	Integrated (Intel HD Graphics 3000)
RAM	8GB DDR3/1333	4GB DDR3/1333
HDD	2TB (5,400rpm)	1TB (7,200rpm)
Optical	Blu-ray player/DVD burner	DVD burner
Display	23-inch, LED backlit	23-inch, LED backlit

BENCHMARKS

	HP TouchSmart 520-1070	Toshiba DX735-D3201
Photoshop (sec)	**83.7**	118.7
MainConcept (sec)	**1,119**	1,861
Premiere (sec)	**659**	840
ProShow Producer (sec)	**563**	1,067
Metro 2033 (fps)	**17.8**	WNR

Best scores are bolded. Metro 2033 benchmarked using DirectX 10 with resolution at 1280x720, quality at medium, antialiasing at MSAA 4x, texture filtering at AF16x, and PhysX disabled. All other benchmarks performed at display's native resolution of 1920x1080.

The Cosmos II has plenty of cable-routing options, and a giant tangle of fan-control cables to go with them.

We'd love the Cosmos II even more if the fan controller didn't beep whenever we changed fan speeds.

The Cosmos II's door panels swing open smoothly on their hinges and can be removed for easier access.

Cooler Master Cosmos II

The once and future king (of cases)

IT'S BEEN five years since the debut of Cooler Master's wildly popular Cosmos chassis, and its successor is finally here. The Cosmos lineage is strong with this one—from the hinged side panels, to the top carrying handles, to the slide-out hard drive trays—but the Cosmos II is a thoroughly modern product with massive cooling potential, strong cable-management chops, and wide-open spaces. The chassis frame is steel, while the shell is plastic, with aluminum cladding on the panels. Our review unit is matte black, but Cooler Master also offers a silver model.

The Cosmos II has three toolless 5.25-inch drive bays, two front-panel 3.5-inch hot-swap SATA bays, and 11 internal hard drive trays in three removable drive cages. Take out the lower two and add an included bracket, and you can install a 240mm radiator in their place; remove the upper hard drive cage, and you can improve airflow in the main compartment.

The main compartment has 10 PCIe expansion slots, plus one on the side, and it supports motherboard form factors as large as XL-ATX. It can accommodate CPU coolers up to 7 inches tall, and 12.2-inch GPUs with room to spare. The motherboard tray contains eight grommeted cable-routing cutouts to the right of the motherboard, two cutouts above it, and two in the divider between the PSU and main compartments. There's more than an inch of room behind the motherboard tray for cable routing.

The case's front panel includes two USB 3.0 ports (with an internal header), four USB 2.0 ports, an eSATA port, and two audio jacks. The case's power and reset switches reside above the front-panel connectors, as does a sleek fan controller that can power as many as nine fans on four different channels.

The Cosmos II ships with five fans: a 20cm front intake, 14cm rear exhaust, 12cm top exhaust, and the previously mentioned two 12cm hard drive bay fans in the lower compartment. The top panel can accommodate as many as three fans, or a radiator as large as 360mm. Each intake fan has a removable dust filter, and the front-panel fan controller manages all but the rear exhaust.

The nine 3-pin connectors are color-coded and labeled, with three for the top fans, three for the hard drive fans, two for the GPU fans, and one for the front fan. The fan controller also has nine 2-pin LED controllers for CM's LED fans, although only the 20cm front fan actually has LEDs. Thank goodness Cooler Master includes plenty of cable-routing options and tie-downs behind the motherboard tray.

Aside from the plethora of fan-control wires, building into the Cosmos II is a snap. The cavernous interior leaves plenty of room for all your high-powered components, and with plenty of support for both air- and water-cooling setups, you'll be able to keep even the hottest rig chilly.

Aside from a few minor quibbles—the sheer size of the case, the fact that the fan controller beeps whenever you change fan speeds, and the inevitable tangle of fan wires—the production version of the Cosmos II is a great case. We foresee it being very popular with folks who need plenty of room for high-performance components, have the space in their offices for the Cosmos II's bulk, and don't mind forking over $350. It's an unabashedly prestige enclosure, but sometimes that's just what we need. **–Nathan Edwards**

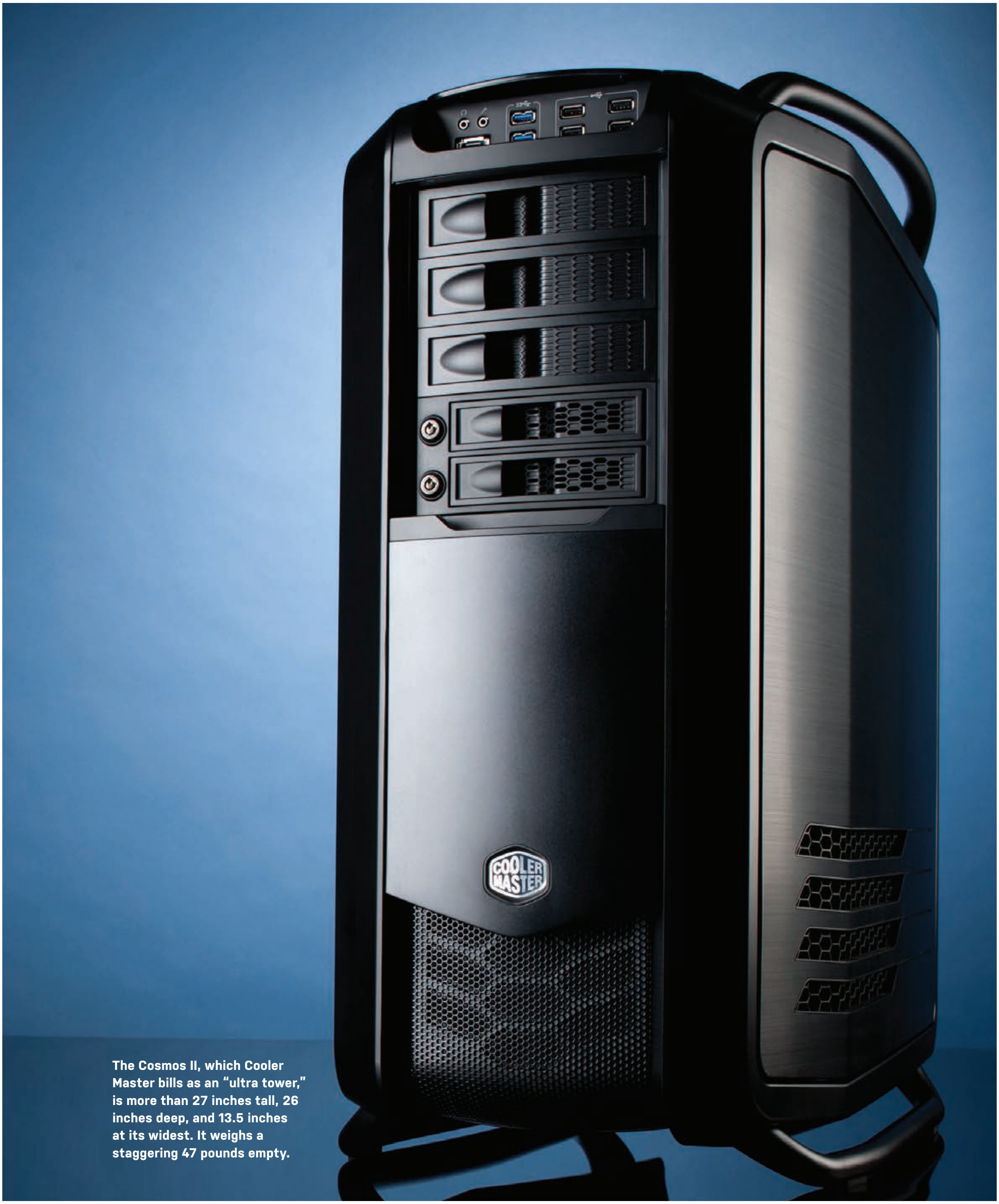
VERDICT 9 KICK ASS!

Cooler Master Cosmos II

+ COSMIC LOVE Huge interior; great build quality; loads of cooling options and hard drive trays.

– INTERSTELLAR GAS So very many fan control wires; enormous; unnecessary beeping.

$350, www.coolermaster.com



The Cosmos II, which Cooler Master bills as an "ultra tower," is more than 27 inches tall, 26 inches deep, and 13.5 inches at its widest. It weighs a staggering 47 pounds empty.

Brushed-aluminum front panels make us drool, especially when they sport USB 3.0 ports.

Silverstone Temjin TJ08-E

A solid compromise between space and performance

SILVERSTONE'S TEMJIN TJ08-E is a micro-ATX chassis that strikes a nearly perfect balance between practicality and performance. The TJ08-E is fabricated primarily from steel, but its front panel is brushed aluminum, with two USB 3.0 ports (with an internal header), a mic input, a headphone output, and power and reset switches. The front I/O ports are located beneath the two 5.25-inch drive bays and above the chassis' only fan, an 18cm Air Penetrator concealed behind a large mesh cover. The fan features an on/off switch built into the side of the case, and there's a large removable dust filter between the mesh cover and the fan.

The TJ08-E is surprisingly roomy for a small form factor chassis. Although it measures just 8.26 inches wide, 15.2 inches long, and 14.7 inches tall, it provides enough interior space to accommodate a GTX 590 videocard without having to move anything. The TJ08-E also provides four internal hard drive slots, a single 2.5-inch mounting bracket, and a dual-purpose 3.5-inch drive bay. We had no problem popping our full-size drives into the bays and securing them with screws, although the backs of the drives protrude from the rear of the hard drive cage. The hard drive cage can be completely removed, in case you need extra room, and a CPU-cooler support at the bottom of the case will prevent a large heatsink from banging against its floor.

The power supply compartment up top is large and accommodating, although installing a PSU requires removal of the case's top panel. A videocard installation, meanwhile, requires screws, as does most every other facet of the TJ08-E. The TJ08-E offers one additional cooling option: mounting holes for a rear 12cm fan. An oversize cutout in the removable motherboard tray is provided for a CPU cooler backplate. We tidied our wiring using the three motherboard tray cutouts; but if your build consists of similarly massive parts, you'll find it tough to cram them into such minimal space.

Windowless steel doors latch to the sides and are secured with thumbscrews. With its doors on and its front fan spinning, the TJ08-E is extremely quiet. We're impressed with all that Silverstone was able to accomplish with the TJ08-E. It looks and sounds great, it's easy to build into, and it's very affordable, with an average street price just over a hundred bones.

We'd have happily bestowed it with a Kick Ass award if it came with another fan and had more than just two fan mounts. But if you're performance-minded and simply don't have space on or around your desk for a full-size tower, the TJ08-E should be on the short list of candidates for your next build. –ALAN FACKLER

Believe it or not, a full-size, 12.2-inch videocard will fit in there.

VERDICT 9

Silverstone TJ08-E

➕ **MICRO MACHINES** Sleek looks; affordable; easy to build into; quiet.

➖ **MICRO ANYTHING ELSE** Gets crowded with full-size components; just one stock fan; fairly limited cooling options.

$110, www.silverstone.com

D-Link's cylindrically shaped DIR-645 router houses a six-element sectorized beam-forming antenna.

D-Link DIR-645 Wi-Fi Router

When you don't need the very best

THE REMARK ABOVE is more than a left-handed compliment. D-Link's DIR-645 isn't nearly as feature-packed as our current favorite wireless router, Netgear's WNDR-4500, but the DIR-645 is nearly as fast on the 2.4GHz frequency band, and it costs almost half as much as Netgear's decidedly kick-ass router.

If you've divided your router requirements into needs and wants, and you've determined that a single-band router is all you need, D-Link's DIR-645 is a good choice. If attaching USB storage to that router is also firmly ensconced in your needs column, on the other hand, you should stay clear of this device. While it's outfitted with one USB 2.0 port that is capable of hosting either storage or a multi-function printer, you must install D-Link's SharePort utility on every computer on your network that needs to use it. And only one of those computers will be allowed to connect to an attached device at any one time.

What's even worse is that the router doesn't provide enough voltage at its USB port to spin up even modern mechanical hard drives. Western Digital's 500GB, USB 3.0 Passport drive would spin up momentarily, but then drop off the network almost as quickly. On the third hand, if NAS is that important, you'll be happier with the genuine article than with any router-hosted solution we've tried. The same goes for networkable multifunction printers, which we did not test. In any event, we didn't deduct more than half a point from our verdict for SharePort's storage device shortcomings.

The DIR-645's unusual cylindrical design accommodates the router's sectorized beam-forming antennas. A sectorized antenna radiates its signal in a horizontal pattern in some portion of the circumference of a circle, while a beam-forming antenna typically delivers higher gain to cover a wider area than an omnidirectional antenna. D-Link claims the DIR-645's six-element antenna will deliver consistently good performance in most any room in a home and eliminate dead spots, too.

Our testing backs up those claims. Although the DIR-645 is capable of producing only two 150MB/s spatial streams simultaneously, it performed almost as well as our zero-point router—Netgear's WNDR-4500—which produces three 150Mb/s spatial streams. In fact, the D-Link outperformed the Netgear at two locations, including our second outdoor spot, where the client is about 70 feet from the router.

The DIR-645's price tag reflects its single-band nature, but D-Link doesn't shortchange you on other features. You can set up a guest zone and choose between allowing guests on to your host network or limiting them to Internet access. And D-Link provides both iTunes and DLNA servers in addition to the usual UPnP server. Quality-of-service tweakers will need to create their own rules, however, and this router has the same, tired web-based user interface that D-Link has relied on for years.

If your budget is tight and your airspace is quiet enough for a 2.4GHz router to thrive, D-Link's DIR-645 delivers a strong price/performance ratio. –MICHAEL BROWN

WIRELESS BENCHMARKS

2.4GHz Band	D-Link DIR-645	Netgear WNDR4500
Bedroom 1, 10 feet (Mb/s)	130.0	**149.0**
Kitchen, 20 feet (Mb/s)	**157.0**	131.0
Patio, 38 feet (Mb/s)	94.2	**107.0**
Home Theater, 35 feet (Mb/s)	68.0	**71.2**
Outdoors, 85 feet (Mb/s)	**32.7**	29.8

WIRED BENCHMARKS

	D-Link DIR-645	Netgear WNDR4500
TCP Throughput (Mb/s)	942.0	**930.0**
PC to NAS, small (sec)	WNR	**125.3**
PC to NAS, large (sec)	WNR	**373.0**
NAS to PC, small (sec)	WNR	**418.7**
NAS to PC, large (sec)	WNR	**104.0**

Best scores are bolded. TCP throughput measured using JPerf. NAS tests consisted of copying a single 2.79GB file and a folder containing 659MB worth of files and folders to and from a USB 3.0 drive attached to the router. N/C indicates no connection at that location. Additional benchmarking methodology at bit.ly/r5USfH.

VERDICT 8 — **D-Link DIR-645 Wireless Router**

+ DEE DEE RAMONE Fast performance, especially at long distance; DLNA and iTunes servers.

– DEE DEE TWINS Operates on only 2.4GHz frequency band; one underpowered USB port; unintuitive web-based UI.

$100 street, www.dlink.com

Acer's H9500BD uses DLP Link 3D glasses, so there's no need for an IR or RF emitter to sync the glasses to the projector.

The center-mounted lens on Epson's Home Theater 3010, combined with the absence of lens-shift support, could complicate your installation if you're upgrading from a projector with an offset lens.

Pleasurable Projectors

Happiness is 3D video on a 100-plus-inch screen

How big is your display? 17 inches? 24 inches? 30 inches? Buddy, you haven't lived until you've played games and watched video on a really big screen. We're talking about a projector screen that's 100-plus diagonal inches—big enough to fill an entire wall. It wasn't long ago that a video projector capable of producing 1920x1080 video in 3D cost more than 10 grand. These three entry-level models from Acer, Epson, and Optoma range in price from less than $1,500 to just over $1,700. Which one's best? –MICHAEL BROWN

ACER H9500BD

Acer's H9500BD 3D video projector is the most expensive of the three models here, but it has a couple of features the other two lack. Its overall image quality, however, is only on par with projectors in this price range. We'll leave it up to you to match those considerations to your needs/wants list.

The H9500BD, like Optoma's HD33, is based on Texas Instrument's DLP technology. When connected to a PC or Blu-ray 3D player via HDMI, the projector is capable of producing frame-packed 3D video at 1920x1080 resolution at a refresh rate of 24Hz (the same frame rate movies are filmed at). If you want to play games, you'll need to drop the resolution down to 1280x720, so you can use a 60Hz refresh rate (markedly better for games).

Unless you'll be the only person watching the projector in 3D mode, though, you should keep in mind that Acer provides only one pair of 3D glasses with the projector; additional pairs of DLP Link 3D glasses cost about $100 each. (Flip over to Lab Notes on page 92 for a longer discussion of what you'll need to drive any of these projectors with an AMD or Nvidia GPU.)

Lens shift is one high-end feature the H9500BD boasts that the other two projectors lack. The ability to physically move the lens inside the projector housing makes it easier to place the projector—be it on a table or mounted from the ceiling—without the need for keystone adjustments if you can't align the projector's lens perfectly with the screen. Keystone adjustments correct distortion at the top, bottom, or sides of the projected image, but they do so by sacrificing resolution and image detail through compression.

The H9500BD turns on TI's Brilliant Color, a feature integrated into DLP chips to boost brightness, by default. This produces a color palette that video purists will criticize as overemphasized, but we like the effect. Black levels are surprisingly good, too. Acer's projector is considerably brighter than Optoma's, but it's about 10 percent less bright than Epson's offering. That difference really comes to the fore when you switch to 3D mode.

This projector looks fantastic in both 2D and 3D; but in 3D mode, the tinted lenses block some of the light reflected from the screen even when their shutters are completely open. Each lens then alternates blocking all light 60 times each second. But if you can darken your room and limit your picture size to 100 inches or less, you should be very happy with this projector.

VERDICT 9
Acer H9500BD
$1,600 street, www.acer.com

EPSON HOME THEATER 3010

The best feature of Epson's Home Theater 3010—a three-chip LCD projector—is its extreme brightness. At 2,200 ANSI lumens, it's 10 percent brighter than the Acer, and more than 18 percent brighter than the Optoma. Its biggest drawback is the fact that it doesn't include lens shift, which could make the projector more difficult to set up without having to resort to quality-compromising keystone adjustments.

If you do need to make keystone adjustments, the 3010 renders horizontal adjustments easy and precise. And when you're running the projector in 3D mode, you'll definitely appreciate that added brightness, since the tinted active-shut-

Optoma's HD33 performs well and is aggressively priced, but you'll need to provide your own 3D glasses.

ter glasses will block a considerable amount of light from reaching your eyes. The trade-off for all that brightness is a black level that's slightly worse than the Acer's. But black remains black, not dark gray, so we think the trade-off is worthwhile.

All three projectors delivered stunning 3D experiences. There's one scene in the IMAX Blu-ray disc *Under the Sea 3D* in which a gargantuan potato cod turns to face the camera, and it looked as though the huge fish was protruding eight feet off the screen and right into the middle of our home theater. But only the Epson could accomplish the trick with complete effectiveness in the presence of ambient light from nearby windows.

Epson provides two pairs of LCD active-shutter glasses, and there's an infrared emitter built into the projector. If that's not suitable for your installation, you can plug an external IR emitter into an RJ-45 port on the back. The 3010 provides the usual complement of video inputs—two HDMI, VGA, composite, and component—but for an extra $200, the model 3010e adds wireless HDMI (although Epson doesn't provide any glasses with this model). Integrated stereo speakers are an unusual feature on both models. We don't imagine anyone would use the speakers with the projector permanently installed in their home theater, but they would come in very handy for backyard movie nights.

The Epson Home Theater 3010 is a great projector. It would be even better with lens shift, but that would likely have rendered it more expensive. If you crave 3D, but have difficulty controlling the ambient light in your home theater, this is the projector to buy.

VERDICT 9

Epson Home Theater 3010

$1,500 street, www.epson.com

OPTOMA HD33

At first glance, Optoma's DLP-based HD33 struck us as the Charlie Brown of this batch. While it was the first 3D video projector in this price range to reach the market, it delivers only 1,800 ANSI lumens of brightness, its zoom lens is limited to 1.2x, and you must buy the 3D glasses separately. Like the Epson, the HD33 doesn't have a lens-shift feature, but it is the least-expensive model we looked at, and its image quality is at least as good as the other two.

The HD33 comes with an RF emitter for synchronizing 3D glasses, but the emitter is a stand-alone device that must be plugged into a VESA 3D port at the back of the projector. Optoma helpfully provides a bit of two-way tape so you can glue it to the projector housing, but it's a tacky (no pun intended) solution at best. The glasses Optoma sent for this review (not included in the price of the projector) were considerably dorkier looking and less comfortable to wear than the glasses Acer and Epson provided. Optoma's glasses are also unique in that they use a rechargeable battery, but that comes with a downside: You recharge them using a Micro USB cable and an AC adapter, which is also not included (although you could plug them into your PC). Alternatively, you can use any manufacturer's DLP Link 3D-compatible glasses. You can expect to pay about $100 per pair for active 3D glasses of any type.

The HD33's low lumen rating means it's not a good choice for rooms where you can't control ambient light. In rooms where you can, however, that rating doesn't impact its 3D performance as much as you would think. That's because the HD33 delivers better contrast in 3D than either the Epson or the Acer. The HD33 produced great color, strong black levels, and very good shadow detail in both 2D and 3D modes. But add $100 to its price tag for one pair of glasses, and its price/performance ratio falls just a little short of both the Acer and Epson models.

VERDICT 8

Optoma HD33

$1,430 street, www.optoma.com

SPECIFICATIONS

	Acer H9500BD	Epson 3010	Optoma HD33
Projection System	Single-chip DLP	Three-chip LCD	Single-chip DLP
ANSI Lumens	2,000	2,200	1,800
Lens Life (normal)	2,000 hours	4,000 hours	4,000 hours
Zoom	1.5x	1.6x	1.2x
Lens Shift	Yes, vertical/horizontal	No	No
Video Inputs	HDMI (2), DVI, VGA (2), component, S-video, composite	HDMI (2), VGA, component, composite	HDMI (2), VGA, component, composite
Video Outputs	VGA	None	None
Picture-in-Picture	Yes	Yes	Yes
Includes 3D Glasses	One pair (DLP Link)	Two pairs (infrared)	No (supports RF or DLP Link models)
Warranty	One year	Two years	One year
Weight (pounds)	15.9	13.2	10.0
Street Price	$1,600	$1,500	$1,430

Asus Eee Pad Transformer Prime

Androidicus Tabletus Optimus

THE FIRST AND SECOND *Transformers* movies were abominations, and Hasbro has sued Asus for violating its Transformers trademark, but there's no denying that Asus's Eee Pad Transformer Prime improves on the original Transformer tablet in nearly every conceivable fashion.

Asus's latest tablet—we'll just call it the Prime—loses the awkward build of its predecessor in favor of a smaller, lighter, and more stylish aluminum-backed chassis. It's actually thinner than the iPad 2—probably as thin as it could be considering it's outfitted with a combo headphone/mic-in jack, a Micro HDMI port, a MicroSD card slot, and a USB/charge/dock port. A matching keyboard dock (a $150 option) adds full-size USB and SD card interfaces and up to 10 hours of additional battery life. The dock provides many helpful keyboard shortcuts, and its keyboard action and trackpad mouse response improve over the original.

Displays have been a consistent high point in Asus's Eee Pad series, including the Eee Pad Slider, and the Prime includes a Super IPS+ display with Gorilla Glass. The screen is highly reflective and smudge-prone, but it looks absolutely beautiful and offers very wide viewing angles. HD video, whether streaming or running off internal memory, exhibited sumptuous detail and color. A new Super IPS+ brightness mode significantly boosts the Prime's brightness level—at the expense of battery life, of course—but the tablet remains difficult to use in bright sunlight. It's an improvement, but there's only so much a manufacturer can do with LCD technology on this score.

Most of the hype surrounding the Prime has focused on the new Nvidia Tegra 3 CPU, a quad-core chip with a fifth "companion core" to handle simple tasks that don't require much power. Asus programmed the Prime with three performance modes to balance performance and power consumption. Normal mode runs a single core at its maximum clock speed of 1.4GHz, or two, three, or four cores at 1.3GHz each. Balanced mode throttles the CPU down to 1.2GHz per core, and Power Saving mode runs the cores at between 600MHz and 1GHz each, depending on how many are running. We kept mostly to Normal mode, natch, and the differences were noticeable.

There aren't many use cases or benchmark tests that show off the CPU's full power; certainly none that reach the 5x gains over the Tegra 2 that Nvidia has promised. Tegra 3–optimized games such as Shadowgun, Riptide, Sprinkle, and Glowball, on the other hand, are endowed with astounding next-generation lighting, water, and motion effects. And thanks to the addition of USB pairing, we played them using a wireless gamepad. These were only demos, however; with any luck, the full games will be available by the time you read this. In any event, we look forward to seeing what else developers can do with the Tegra 3's horsepower. There's potential for this Honeycomb tablet to become a formidable portable game console.

Asus has also enhanced the UI overlying stock Honeycomb, with features such as a much-improved notifications/settings pop-up menu that provides many more helpful shortcuts than the other Eee Pads. In fact, web browsing is just about the only area without huge performance gains; the CPU speeds up some rendering tasks, but that's about it. The stock browser also still occasionally exhibits frustrating nonresponsiveness to touches. The advertised battery life of about eight hours held up in our tests: The tablet lasted seven hours and 42 minutes looping a 720p video in Normal CPU mode with brightness and volume set at 50 percent.

All told, the Eee Pad Transformer Prime stands out as the most impressive Android tablet to date. The only thing holding it back is an update to Android 4 Ice Cream Sandwich, which Asus says is forthcoming. With a promising new OS on the way and a price tag equal to a 16GB iPad 2, the Prime could herald the rise of the real Android tablet market. **–Markkus Rovito**

SPECIFICATIONS

OS	Android Honeycomb 3.2.1 (upgradeable to 4)
Processor	1.3GHz quad-core Nvidia Tegra 3 w/1GB RAM
Display	10.1-inch Super IPS+ LED backlit, 1280x800 (WXGA)
Storage	32GB internal; 8GB Asus Webstorage; Micro SD expandable
Cameras	8MP rear with auto-focus and LED flash; 1.2MP front
Connectivity	Wi-Fi, Bluetooth 2.1, Micro HDMI, USB 2.0 (proprietary cable)
Size/Weight	7.1x10.4x0.31 inches/1.29 lbs.

VERDICT 9 KICK ASS!

Eee Pad Transformer Prime TF201

+ **PRIME RIB** Huge gains in CPU and graphics performance; fantastic display; top-notch industrial design; excellent keyboard/expansion dock.

− **SUBPRIME** Browser performance still feels last-generation; very little Tegra 3–optimized software at this point.

$500 (32GB) or $600 (64GB), www.asus.com

Detached from the dock, the stand-alone Transformer Prime rivals any other tablet for design and performance.

She's a beaut: The Transformer Prime comes in either Amethyst Gray (pictured) or Champagne, in capacities of 32GB ($500) or 64GB ($600).

Samsung's T27A950 is a versatile 3D display, featuring DLNA-compliant networking via hardwired Ethernet or a user-provided USB Wi-Fi dongle. It has two HDMI inputs and an optical digital audio output, and it can host a USB thumb drive.

Samsung SyncMaster T27A950 3D Display

Impressive looks; less-than-impressive performance

WHEN SAMSUNG DEMOED the T27A950 for us a few months back, we got excited. This 27-inch, 120Hz display looks sleek and sophisticated, and it offers a long list of features, including an onboard digital HDTV tuner, picture-in-picture capability, DLNA-compliant networking, Samsung's collection of smart TV apps, and active 3D. We couldn't wait to get it in the Lab for a better look.

It didn't take long for our excitement to ebb. The unconventional stand that makes the monitor stand out from the crowd severely limits the panel's range of movement. You can tilt it forward and back by a few degrees, but you can't adjust its height, pivot it into portrait mode, or mount it to a wall or any alternative stand.

The capacitive touch controls for the onscreen menus deftly eliminate ugly mechanical buttons, but they didn't always respond to our first touch; and while they disappeared when inactive, our smudgy fingerprints did not. Fortunately, Samsung provides an infrared remote control, so you don't need to touch the shiny bezel. The onscreen menus themselves are a mixed bag. We appreciated the context-sensitive explanations that pop up, but having to press the volume-up control to choose menu categories, instead of the menu or source control, had us repeatedly pressing the wrong button.

Adjusting the T27A950's picture to achieve good performance in DisplayMate (www.displaymate.com) proved to be a major struggle. Although this monitor produces exceptional detail and texture, its colors are under-saturated and its black level became washed out unless we turned the LED backlight down very low. But as you might expect, substantially reducing the backlight renders the entire image too dim, even after cranking the brightness.

We were never able to achieve a satisfying balance using these two controls, so it should come as no surprise that this monitor also delivered poor performances on DisplayMate's dark-screen, dark-gray, and grayscale compression tests. We detected substantial backlight leakage on the dark-screen test, and the monitor had difficulty producing smooth gradations from the deepest black to the lightest gray.

The T27A950 also delivered subpar performances on DisplayMate's 256 Intensity Level Color Ramp and Gray Scale Range tests, producing visible streaking, jumps, and skips. We detected objectionable moiré patterns in our Blu-ray (*V for Vendetta*) and game (Batman: Arkham Asylum) tests, too. The monitor's 3D performance in games and movies was, on the other hand, surprisingly good. Samsung licensed DDD's TriDef technology and an emitter built into the monitor synchronizes the display to Samsung's active LCD shutter glasses (the monitor comes with one pair).

The one area in which the monitor excelled was rendering text, which surprised us considering this is a 27-inch display that's limited to a TV-like 1920x1080 resolution. When all is said and done, this would be a better small TV than a large computer monitor if not for one issue: its $800 price tag. –AMBER BOUMAN

VERDICT 6

Samsung SyncMaster T27A950 3D Display

+ PLAY-DOH Sleek design; easy 2D-to-3D conversion; networkable; great detail.

– D'OH! Pricey; highly reflective; difficult to calibrate; fancy stand offers few adjustments.

$800, www.samsung.com

At 5.15x2.7x0.28 inches and 4.5 ounces, the Motorola Razr is almost flat and wide enough to flip a pancake.

Motorola Droid Razr

This buzz phone looks sharp and performs on point

THE MARKETING BLITZ swirling around the Droid Razr's launch drive home these twin selling points: thin, yet powerful. This wafer of a smartphone measures just over a quarter of an inch thick along most of its chassis before filling out at the top where the camera lens and flash; speaker; and HDMI, USB, and headphone jacks reside. A layer of Kevlar fiber drapes the backside, and the Gorilla Glass covering the 4.3-inch display has a water-repellent coating for protection against errant spills and inevitable raindrops.

For all its vaunted thinness, the Razr feels very sturdy in your hand, while its substantial surface area assures that it doesn't feel small. If anything, it's a bit unwieldy for one-handed operation. The thin build has its share of downsides, too: The side-mounted power and volume buttons are too small, and this is one of the rare Android form factors that doesn't let you remove the battery.

We do, however, cherish the generous qHD Super AMOLED Advanced display, which exhibits vivacious colors and deep black levels. The Razr is one of the first smartphones to allow Netflix streaming in HD; and for what it's worth on a screen this size, movies, other HD video, and games look extraordinary.

The Razr's 1080p video recording isn't quite as impressive, but it's certainly good enough for us to keep our pocket camcorder at home; we think minor image noise and motion blur are forgivable on a smartphone. Shots from the 8MP rear camera look much better, with excellent contrast and detail, at least when conditions are favorable. The camera struggles somewhat in low light, and we found its image stabilization only slightly effective.

Aside from instability with Google Music (DoubleTwist worked fine), and a bug that doesn't pass audio through the HDMI output, the Razr performed admirably in our testing. Basic operations such as screen swipes and website scrolls flowed effortlessly, as did high-end mobile games—including the bundled Madden NFL 12.

We've sampled each of the major carriers' so-called 4G options in the San Francisco Bay Area over the last year, and Verizon's 4G LTE has beaten the competition mercilessly. Verizon's network enabled the Razr to deliver silky-smooth video and music streaming as well as web browsing. The average download speeds of 5,806Kb/s and upload speeds of 4,433Kb/s we measured are lower than what we've seen reported in some other areas of the country, but Verizon's network thumped the competition in this region.

Battery life varies greatly depending on how much you're taxing the Razr's 1.2GHz dual-core OMAP and its 4G data connection, but we were able to squeeze out slightly more than 24 hours of moderate use on a single charge, and that included a few hours of podcast listening, a couple hours of streaming video, and about an hour of talk time. That's quite good, but wear on that nonremovable battery could be a problem over time.

As usual, both Motorola and Verizon go heavy on the bloatware, which can't be uninstalled without root access. MotoCast, however, delivers some real value. It connects the Razr to your networked PC wirelessly, so you can stream media or transfer files to and from your phone from anywhere.

If you like a large display, the Droid Razr gives you a whole lotta smartphone with little downside. While the $300 price tag (with contract) sits at the high end, healthy competition all but ensures that deals will be available sooner rather than later. –MARKKUS ROVITO

SPECIFICATIONS

OS	Android Gingerbread 2.3.5 (upgradeable to 4.0)
Processor	1.2GHz dual-core TI OMAP4460 w/1GB RAM
Display	4.3-inch Super AMOLED Advanced, 960x540 (qHD)
Storage	16GB internal; 16GB Micro SD installed (black model only)
Cameras	8MP rear with auto-focus and LED flash; 1.3MP front
Video	1080p at 30fps rear; 720p front
Connectivity	Wi-Fi, Bluetooth 4.0, 4G LTE, Micro USB 2.0, Micro HDMI
Battery	1,780 mAh Li-ion, nonremovable

VERDICT 8

Motorola Razr

+ FUSION PROGLIDE Excellent, large display; high-end CPU and graphics; 32GB memory; 4G LTE with mobile hotspot capability.

– BOX CUTTER Nonremovable battery; occasional bugs; small buttons and large frame make for difficult one-handed use.

$300 on Verizon contract, www.motorola.com

Turtle Beach Ear Force Z6A

A 5.1-channel headset only a gamer could love

IF YOU'RE A LONGTIME PC user, you might remember Turtle Beach as one of the original manufacturers of computer audio hardware—we're talking soundcards that competed with the best that Creative Labs had to offer. You might also have been dismayed in recent years, as the company became known for producing high-end headsets aimed primarily at console gamers. Turtle Beach has never forsaken its roots, though; its lineup has always included some solid offerings for the PC. The Ear Force Z6A is the latest in that line.

The Z6A features perfectly respectable build quality, with ear cups that swivel and flex to fit comfortably on any shape of head. The padding on the headband and the ear surrounds isn't exactly plush, but we found it comfortable enough for extended wear. As is generally the case with Turtle Beach products, the Z6A boasts stylish design, with sharp-looking chrome accents and deep blue detailing.

Turtle Beach describes the Z6A as a "true 5.1" headset because it includes a six-channel amplifier driving four speakers—front, center, surround, and low-frequency effects—inside each ear cup to deliver more realistic positional audio. The front and surround drivers are tilted to help your ear localize the source of each sound, presumably by introducing microsecond delays so that each sound reaches your eardrum at a slightly different time. Using the amplifier, you can adjust the front, center, surround, and LFE volume levels independently.

The headphones are considerably more directional than a conventional two-channel headset, and they deliver strong mid and high frequencies. We found their bass response, on the other hand, to be a little weak—particularly while listening to music and movie soundtracks. We encountered some other shortcomings, too. The heavy in-line amplifier—which draws power from your computer's USB port—is at such a position on the cable that it usually sits in your lap.

As an analog headset with three surround inputs and a mic jack, it's not going to work with most notebooks, which lack multichannel output. But that's the price to be paid, as gaming multichannel audio through analog is still superior to USB digital schemes.

We must note that Turtle Beach offers a host of optional adapters that will let you use the Z6A with any setup, but they cost extra.

If your computer has the right audio outputs and you want headphones capable of delivering directional audio for games, and if you have another set of phones for listening to music and watching movies, the Z6A is a fine choice. **–Alex Castle**

VERDICT 8

Turtle Beach Ear Force Z6A

+ NINJA TURTLES Good directionality; solid build quality; clear sound for gaming.

– TURTLE SOUP Poor bass response; a surfeit of cables.

$100, www.turtlebeach.com

Turtle Beach's Ear Force Z6A headset delivers bona fide surround sound, but it depends on analog audio connections.

Star Wars: The Old Republic

A fabulous single-player experience in a massively multiplayer online game

STAR WARS: The Old Republic (TOR) comes with a buffet of a story for an MMO, but you only get to fill your plate once. From decisions as significant as choosing your character's class specialization to events as trivial as responding to key dialog options, everything you do has a lasting and permanent effect on your gameplay. We like the feast: BioWare's masterful use of instanced environments creates more captivating gameplay for the solo quester than most any other MMO.

But this is BioWare's first foray into the massively multiplayer world, and it shows. TOR is more a role-playing game you play alongside 999,999 friends than a true MMO. BioWare either poorly integrates or completely misses the mark on many of the elements that define an MMO. On the upside, the beautiful blend of voice acting and dialogue options in each of TOR's many quests should earn the game a celebratory parade through the Yavin 4 throne room. And while the scripted quests (occasionally punctuated by John Williams's familiar score) are immersive, they make the rest of the game's environments seem stale by comparison. TOR's non-instanced "generic" areas just aren't very player-interactive. The Nar Shadda casino, a cold and lifeless location that cries out for mini-games and interactivity, is just one example. And don't get us started on TOR's cantina music.

Whoever designed TOR's sprawling landscapes (and transportation flowcharts) deserves to be Force choked. Traveling feels like marathon training until you gain the Sprint power at level 15, or player vehicles at level 25. Even then, you can probably alt-tab out and watch the full Battle of Hoth while you auto-run your journey between planets, space, and your ship to fulfill various missions.

TOR isn't designed so you can amass armies of friends to take out a faction leader, nor is it even really geared for generic player-versus-player prior to level 50. It's telling that even on a PvP server, it took us until level 27 (out of 50) to encounter our first enemy player in the wild. TOR's instanced PvP matches are simple and fun—yes, even Huttball—but BioWare's decision to have power-boosted lowbies play alongside top-level characters is baffling.

TOR's general combat is challenging and interactive. It includes targetable combustibles that can deal significant damage to nearby enemies, and pop-up bonus objectives that give players more of a reason to fight. That said, the boss fights of TOR's group instances, or Flashpoints, aren't very impressive through midgame: The strategies are simple and the tanking and spanking is prevalent.

And then there are the omissions: TOR's space combat system is more Rebel Assault than TIE Fighter, and it's pathetic to see no Flashpoint matchmaking system beyond shouting "LFG" in general chat. There's no true guild support beyond just having one, no in-game achievements for the boastful, and absolutely no UI customization or add-on support to speak of. The game's Legacy features—beyond granting a player access to a last name around level 30 or so—are even labeled within the game with a big fat "coming soon." Come *on*.

But no MMO can go from Padawan to Jedi Master (or Darth) in a single launch window: If BioWare can complement the game's excellent single-player experience with more of the MMO genre's successful staples (including a stronger implementation of the features we enjoyed in, say, Star Wars: Galaxies), then The Old Republic could very well be the "prequel" that beats out some of the MMO landscape's big original titles. How many times do you get to say that about anything Star Wars? –**DAVID MURPHY**

Keep an eye out for clickables (or killables) during normal quests, and you could earn some tasty experience from self-updating bonus objectives!

VERDICT 7

Star Wars: The Old Republic

➕ **REVAN** Wonderful single-player instancing; immersive scripting and voice-overs; strategic general combat.

➖ **MALAK** Feels incomplete; missing modern MMO features; tough transportation flow; overly simple group co-op.

$60 (Standard), $80 (Digital Deluxe), or $150 (Collector's Edition); plus $14.99 per month, www.swtor.com, ESRB: T

LAB NOTES

MICHAEL BROWN **REVIEWS EDITOR**

3D and the Home Theater PC

The hardware is only half the equation

THE ABSOLUTE best way to enjoy 3D—be it games or movies—is on a really big screen. And for that, you need a 3D-capable projector like the ones I reviewed on page 84. But if you're using a home theater PC, you'll need to jump through some hoops.

Nvidia deserves credit for making desktop stereoscopic 3D popular, but its 3D Vision kit won't work with 3D projectors or HDTVs in the living room. To get a return on its investment, Nvidia requires that you buy its 3DTV Play software ($40) to make its GPUs compatible with third-party glasses.

AMD has expended much less capital on its 3DHD initiative, so there are far fewer 3D games that support its technology natively. You don't need to buy anything extra to use an AMD GPU with 3D projectors and HDTVs, but you will need to buy DDD's TriDef app ($50) to play non-native-3DHD games in 3D.

Markkus Rovito
Senior Editor

During Asus Transformer Prime testing, I depended on the Skifta software to stream movies (or music or photos) from a PC to the tablet. Skifta basically turns your PC or Android device into a DLNA- and UPnP-compliant streaming server. Shuttle media to or from your tablet/phone/PC to any compatible TV, media box, etc. Get free downloads at Skifta.com.

Alex Castle
Online Managing Editor

I recently received a review unit of the SRW-S1 racing wheel, an amazingly solid-feeling and button-laden product. As a lover of gaming hardware, it makes me sad that I don't much care for any of the super hardcore flight or racing sims. I find the games a complete snooze, but they've got by far the best peripherals on the market.

Amber Bouman
Online Features Editor

I've probably talked about my love of Spotify before (Facebook integration notwithstanding), but now that I've been tasked with writing a roundup of streaming music services, can it remain my favorite in the face of competition from Rdio, Slacker, Turntable.fm, Grooveshark, and Google Music? We'll see. At least I'll always have something to listen to.

Alan Fackler
Associate Editor

I got around to it a bit late, but L.A. Noire is truly a phenomenal game. I give it so much credit because, despite the game's numerous flaws, Rockstar clearly went out of its way to try something new and different, and pulled it off with ingenuity to spare. And the hype was true: I've never seen such realistic in-game faces in my life, period. We will breach the uncanny valley, and soon.

Gordon Mah Ung
Deputy Editor

I did some quick testing of notebooks with integrated graphics and found that there's good reason to add more RAM if your notebook only has single-channel memory. The short of it is that adding a second SO-DIMM is worth it if you're running IGP and you want more gaming performance. See the full story here: bit.ly/yh3RGb.

LETTERS

WE TACKLE TOUGH READER QUESTIONS ON...

> Digital Editions
> PC Gaming Suspects
> The Price of Old Tech

Digital Editions Revisited

After reading EIC Katherine Stevenson's response to Bruce Noren in the January Comments section, I am wondering why she didn't just tell Bruce to go to www.calibre.com and use that sweet little free program to change his digital subscription (if he got one) to whatever his reader could use.

This program is fast as hell—it changed over 7,000 books from one format (Kindle) to another (Nook) overnight and changed over 900 books from one (Nook) to another (Kindle) in less than three hours. So far, more than five members of my family have e-book readers; all are voracious readers who constantly buy e-books from the author or a retail site, and we are constantly trading or giving books to each other. And soon there will be three to five more members with e-book readers. This is not illegal in any way, as you have legally paid for the book and you are now doing exactly what the public library is doing, only you are doing it inside your own family.

—Daniel Gray

EDITOR IN CHIEF KATHERINE STEVENSON RESPONDS: Thanks for the tip on Calibre, Daniel. We actually ran a How To about using this handy program for managing and converting e-books in our July 2010 issue (you can read it online here: bit.ly/AEYve7), and you are absolutely right that it can be used to just as easily make legitimately purchased digital magazine subscriptions readable on the device of your choice.

CUT, COPY, PASTE

We incorrectly attributed the February Head to Head article to Brad Chacos. It was written by Markkus Rovito.

Blame the Youts

With all of the obvious suspects out on the table, the case for who tried to kill PC Gaming (Ed Note, February 2012) is definitely an intriguing one. I suspect that one other suspect has not been identified and is still at large. The first group that comes to mind is the gaming community, more specifically, adolescent, transient gamers. These little brats have been growing up in a world simplified by technology and have an overwhelming sense of entitlement when it comes to gaming, among other aspects of life. The aforementioned "Console Brothers" played a part in the attempt to murder our beloved PC Gaming by injecting themselves into the everyday lives of these youthful, evanescent minds. Any electronic retail worker will tell you that holiday sales in the Video Game department are like the riots of Bloody Sunday, with no product display spared. Motivation for such a phenomenon has led to record amounts of consoles in homes in 2012. Grabstats.com reports that 190 million households (presumably in the U.S.) have seventh-generation consoles in the living room/bedroom. Once again, it's not the "Brothers" who are the likely culprit, but the users. Just my thoughts.

—Guillermo De La Cruz

CHIEF PC DETECTIVE GORDON MAH UNG RESPONDS: That's a great point and something I should have considered. Believe it or not, in any homicide case, the chief suspects will always first be family. In fact, in an incident in 2006, PC Gaming had just left his office and decided stop at a local fruit stand to buy oranges. There, he was shot five times by two unknown assailants with .38 Special revolvers. PC Gaming miraculously survived the attack. I have no doubt that someone within PC Gaming's own family was involved in the attack but have never had the evidence to prove it.

Furious Five

I have a bone to pick with the reviewer who gave the Western Digital WD TV Live a 9/Kick Ass rating in your January 2012 issue. I have been using the earlier model of this device for more than a year with a USB 802.11n adapter. When I read that this new model includes built-in Wi-Fi, I got really excited. But it turns out that it does not work on the 5GHz band, and you cannot use an external USB adapter. I was very disappointed with this new item, and it has gone back to the store where I got it. Buyer, beware!

—Michael Keylin

REVIEWS EDITOR MICHAEL BROWN RESPONDS: You're correct, I should have pointed out that the WD TV Live's integrated adapter is limited to the 2.4GHz band.

↘ submit your questions to: comments@maximumpc.com

Although the 5GHz band delivers much less range, it is much less crowded and therefore better suited to critical applications such as media streaming. But I stand by my 9/Kick Ass verdict, because nothing comes close to beating this product's price/performance ratio.

> THESE LITTLE BRATS HAVE AN OVERWHELMING SENSE OF ENTITLEMENT WHEN IT COMES TO GAMING

BoB Soundcard Advice

I love your Best of the Best list. So much so, I built a new PC based on it (mostly for Battlefield 3). I bought the Asus P8P67 Evo with SLI'd EVGA GTX 560s. I had a PCI Audigy 4 soundcard in my old rig, which worked great. However, with the Evo mobo and both graphics cards, using the PCI slot isn't much of an option, as it blocks the fan on the graphics card. What PCIe soundcard would you recommend, if any? Would it be possible to add one to your list? FYI, I use Logitech's Z-5500 sound system.

—Jack Garbett

DEPUTY EDITOR GORDON MAH UNG RESPONDS: PC audio isn't what it used to be, but I still prefer a discrete card over onboard if I have the space for it, for fidelity's sake. I'd probably narrow my choices down to three products: Creative's X-Fi Titanium, if you still need multichannel audio (an X-Fi Titanium PCIe in OEM form can be found for about $85 and is essentially a Fatal1ty board without the cover). If you're a gamer and use big cans, the X-Fi Titanium HD or Asus's Xonar Essence STX are good choices.

Old Tech, New Prices

I decided to look at the "Builders Creed" computer from your November 2010 issue so I could see how prices have dropped. To my surprise, the price for the mobo and GPU were higher! I couldn't find any prices that came close to $289 for the GPU. What gives? Is there some sort of secret I'm missing to buying components?

—Jackson Sardello

DEPUTY EDITOR GORDON MAH UNG RESPONDS: Jackson, there's old technology and then there's *old* technology. Your problem is that you're looking at hardware from November 2010. The GPU, the Asus ENGTX 470, has long since been discontinued. Likewise, the Asus P7P55D-E Pro motherboard is long dead, and it's made more obsolete because it uses Socket LGA1156, which has since been replaced by LGA1155. Because LGA1156 boards are hard to find, the prices are inflated to unrealistic levels.

[NOW ONLINE]

THE TOP 50 TECH STORIES OF 2011

If we built a time machine, we wouldn't have to travel back a great distance to find a far different tech world than the one we live in today. If you could go back to 2010, imagine the money you could make by placing seemingly absurd bets on the near future. There was not a single person in 2010 who thought Duke Nukem Forever would ever see the light of day, or that HP could have seriously considered cutting off its PC division.

Yep, 2011 has been a crazy year, with plenty of wild headlines and plot twists. As the new year gets under way, we've gone and assembled a gallery of the top 50 news stories of 2011. Flip through them at bit.ly/tHeBKe.

[NEXT MONTH]

COMING IN MAXIMUM PC'S SWEETENED WITH PURE AGAVE NECTAR APRIL ISSUE

Websites You Need to Know About

From the trippy to the truly useful, we'll turn you on to a bunch of kickass websites that should be part of your regular rotation.

LGA2011 Coolers

If you want to keep your Sandy Bridge-E chip cool—and who wouldn't?—tune in for Nathan Edwards's comparative reviews of 9 LGA2011 coolers.

Intel Core i7-3820

Speaking of Sandy Bridge-E... Next month we'll benchmark the sub-$300 version of Intel's hot new CPU. Is it a 2600K killer?

Sponsored by newegg.com
Get the latest prices at Newegg.com

HARDWARE

FULL-TOWER CASE

Cooler Master Cosmos II

Cooler Master's Cosmos II was a long time coming, but it was worth the wait.

A preproduction version of the Cosmos II held our 2011 Dream Machine, and the production version is even better.

With support for up to four graphics cards, nine fans or three radiators, and 11 hard drive bays (not counting two hot-swap bays), the Cosmos II can handle all the hardware you can throw at it.

It's a thoroughly modern case, with a four-channel fan controller, internal USB 3.0 headers, and plenty of cable-routing options, too.

It's also enormous, but if you've got it, flaunt it!

www.coolermaster.com

THE REST OF THE BEST

High-End Processor
Intel 3.3GHz Core i7-3960X
www.intel.com

Midrange Processor
Intel 3.5GHz Core i7-2700K
www.intel.com

Budget Processor
Intel 3.3GHz Core i5-2500K
www.intel.com

LGA1155 Motherboard
Asus P8Z68-V Pro
www.asus.com

AM3 Motherboard
Asus M5A99X Evo
www.asus.com

Price-No-Object GPU
Asus GeForce GTX 590
www.asus.com

Performance GPU
XFX Radeon HD 6970
www.xfxforce.com

Midrange GPU
EVGA GeForce GTX 560 Ti 448
www.evga.com

Budget GPU
XFX Radeon HD 6870
www.xfxforce.com

Performance Hard Drive
Samsung 830 Series SSD 256GB
www.samsung.com

Capacity Hard Drive
Hitachi Deskstar 7K3000 3TB
www.hitachigst.com

Air Cooling
Cooler Master Hyper 212 Evo
www.coolermaster.com

High-End Cooler
Prolimatech Armageddon
www.prolimatech.com

Blu-ray Drive
Plextor B940SA
www.plextor.com

Full-Tower Case
Cooler Master Cosmos II
www.coolermaster.com

Mid-Tower Case
Corsair White Graphite Series 600T
www.corsair.com

Midrange Display
LG E2370v
www.lg.com

For even more Best of the Best entries, such as speakers and budget components, go to www.maximumpc.com/best-of-the-best.

THE GAMES WE'RE PLAYING

The Elder Scrolls V: Skyrim
www.elderscrolls.com/skyrim

Batman: Arkham City
www.batmanarkhamcity.com

Terraria
www.terraria.org

Star Wars: TOR
bit.ly/tVffnz

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